WY-120 Maintenance Manual

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Overview

HOW TO USE THIS MANUAL

This manual is divided into six sections and two appendixes, as follows:

Section 1, "Removal and Replacement Procedures," shows you how to take the terminal apart.

Section 2, "Troubleshooting," provides flowcharts for each of the major circuits in the terminal.

Section 3, "Adjustments and Alignments," describes power supply and terminal adjustments that control the quality of the display.

Section 4, "Theory of Operations," describes the terminal operation by function.

Section 5, "Parts List," includes a list of terminal and keyboard assembly parts, as well as silkscreens of the component locations.

Section 6, "Schematics," contains schematic representations of all the terminal's circuits.

Appendix A, "Display Inspection with the Reticle" shows you how to use the reticle to check whether the display is within specification.

Appendix B, "Specifications," provides basic information about the terminal's qualities and abilities.

Safety Summary

This terminal contains high voltage. Don't attempt to service the terminal without taking the following precautions:

- Turn the terminal off and disconnect the power cable
- Remove jewelry from your hands and wrists
- Avoid wearing clothing made of synthetic fabrics
- Use insulated or nonconductive tools
- Handle circuit boards only by their edges
- Don't reconnect the power cable or turn the terminal on unnecessarily while the top cover is removed
- Whenever you disconnect the anode from the anode lead, make sure to discharge the anode as directed in Section 1.

⚠ **Warning** The CRT/yoke assembly has high voltages. Only qualified service personnel should adjust it.

- If you need to remove or replace the CRT/yoke assembly, remember that it can implode if you drop it or break the neck. The flying glass can injure anyone within a radius of ten feet.

⚠ **Warning** Always use the manufacturer's replacement components. Especially critical components as indicated on the circuit schematics should not be replaced with any component other than the manufacturer's. Where a short circuit has occurred, replace those components that indicate evidence of overheating.

INTRODUCTION

The WY-120 terminal is an ergonomic terminal, supporting ASCII, ANSI, and PC Term operating modes. The following features are present:

- Borderless, full-screen video
- Choice of three keyboards: ASCII, ANSI, and Enhanced PC-style
- Hidden or nonhidden attribute modes
- Multipage memory: 1-7 pages in personalities with nonhidden attributes; 1-3 pages in personalities with hidden attributes
- Display formats:

Refresh	Number of Lines	Number of Columns	Character Cell Size	Character Matrix
60 Hz	26	80	10x16	7x12
60 Hz	26	132	9x16	7x12
78 Hz	26	80	10x13	7x10
78 Hz	26	132	9x13	7x10

- Double-high characters on a line basis
- Double-wide characters on a line basis
- Smooth scroll at different software controlled rates
- Soft fonts: Four 128-character fonts selectable on character basis in hidden attribute mode and on screen basis in nonhidden attribute mode
- Battery backup for setup parameters and programmed key definitions in RAM

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1 Removal and Replacement Procedures

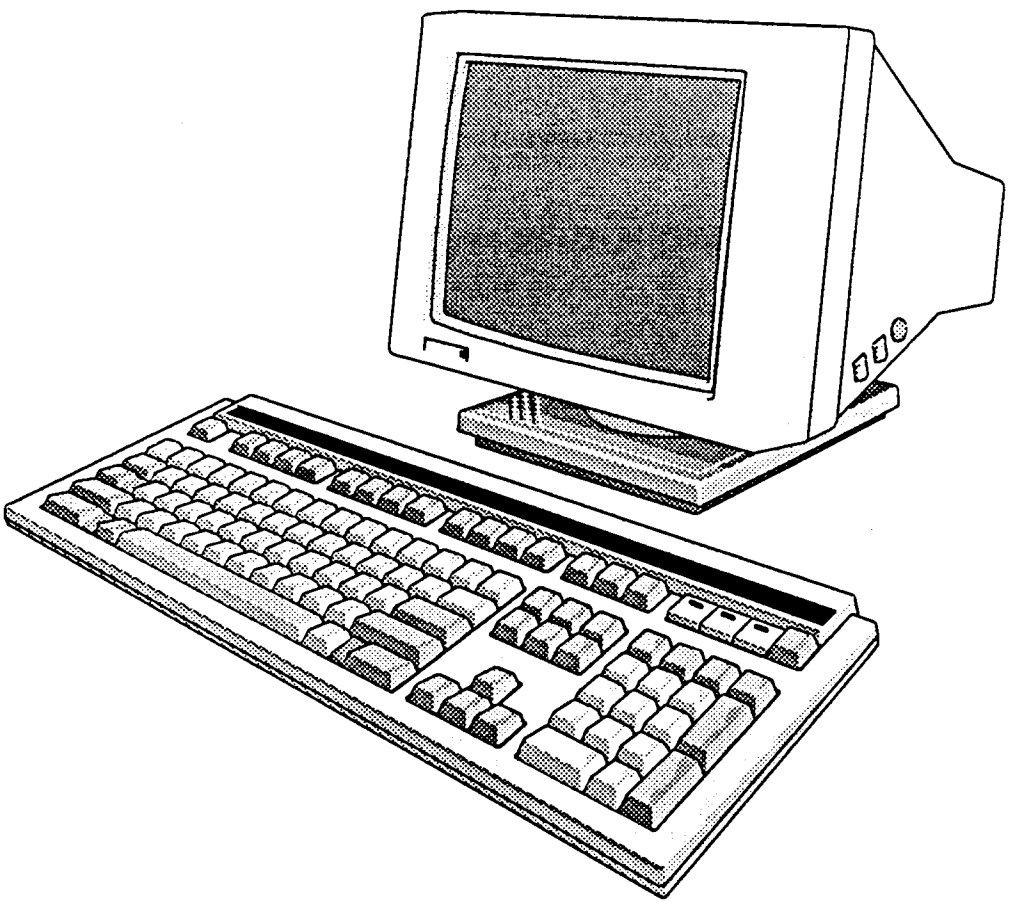
OVERVIEW

This section explains how to remove and replace assemblies in the terminal. We recommend that you read through all the instructions thoroughly before starting to disassemble the terminal.

The terminal consists of two major modules (see Figure 1-1):

- The *terminal module* includes the CRT/yoke assembly, the terminal PCB, and the CRT driver PCB. The terminal PCB holds all control logic and power supply circuitry.
- The *keyboard module* includes the keyboard PCB and the keyboard cable.

Figure 1-1 Terminal Modules



Safety Requirements

⚠ **Warning** This terminal operates on voltages that can be lethal. Don't attempt to service the terminal without taking the following precautions:

- Turn the terminal off and disconnect the power cable.
- Remove jewelry from your hands and wrists.
- Avoid wearing clothing made of synthetic fabrics.
- Use insulated or nonconductive tools.
- Handle circuit boards only by their edges.
- Don't reconnect the power cable or turn the terminal on unnecessarily while the top cover is removed.
- Whenever you connect or disconnect the anode from the anode lead, make sure to discharge the anode as directed in "Discharging the Anode."

⚠ **Warning** The CRT/yoke assembly has high voltages. Only qualified service personnel should adjust it.

- If you need to remove or replace the CRT/yoke assembly, remember that it can implode if you drop it or break the neck. The flying glass can injure anyone within a radius of ten feet.
- Always use the manufacturer's replacement components. Especially critical components as indicated on the circuit schematics should not be replaced with any component other than the manufacturer's. Where a short circuit has occurred, replace those components that indicate evidence of overheating.

Required Tools

Before removing or replacing any assemblies, make sure you have the following tools:

- No. 0 and No. 2 Phillips screwdrivers
- Insulated flat-blade screwdriver
- Alligator clips
- Digital voltmeter
- Nonscratch mat or surface on which to place the terminal
- Fuse puller or small flat-blade screwdriver
- Nonconductive alignment tool

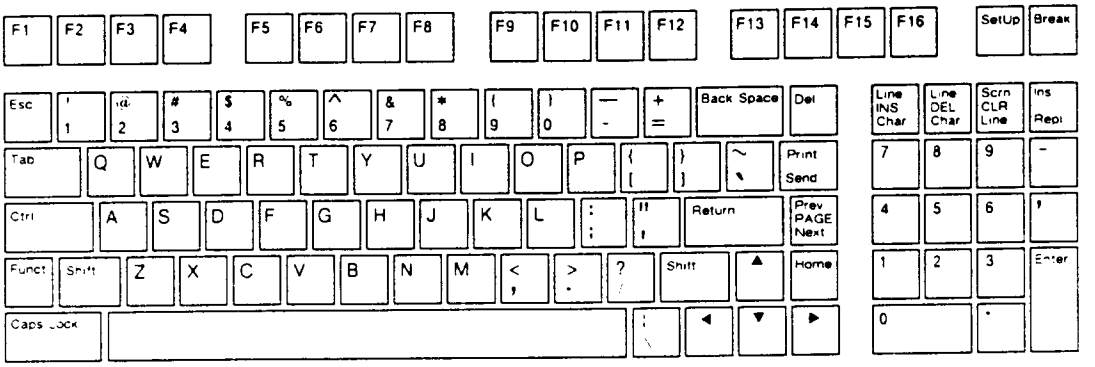
KEYBOARD MODULE REMOVAL AND REPLACEMENT

The terminal keyboard style options are

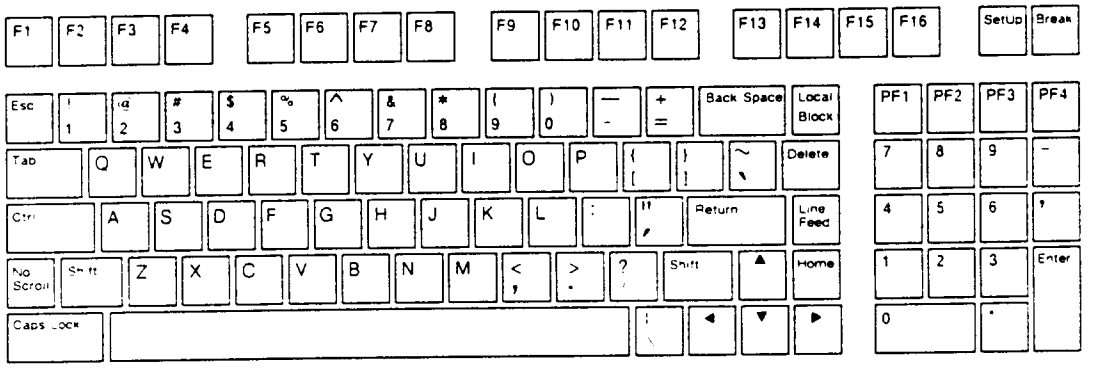
- ASCII
- ANSI
- Enhanced PC

Figure 1-2 identifies each keyboard. Procedures for removing and replacing the keyboards, keyboard cables, and keyboard PCBs follow.

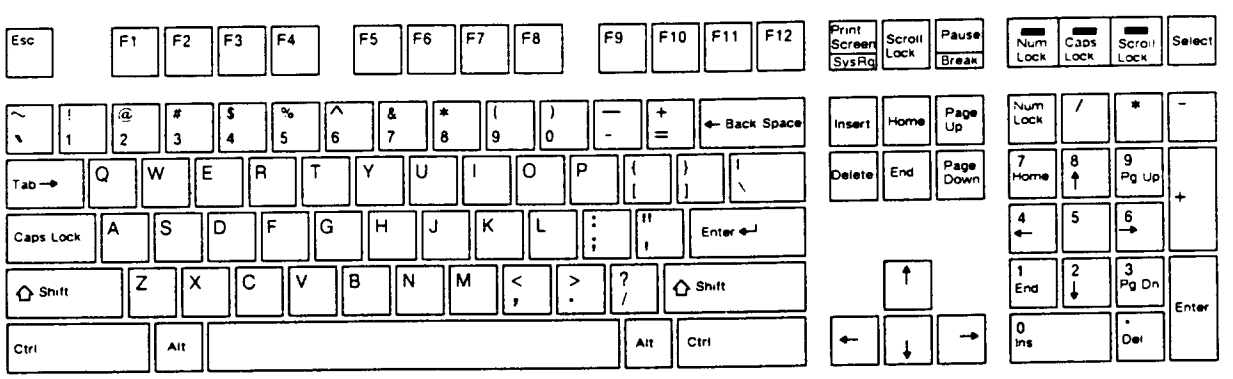
Figure 1-2 Keyboard Styles


F1 F2 F3 F4 F5 F6 F7 F8 F9 F10 F11 F12 F13 F14 F15 F16 SetUp Break
Esc Back Space Del
Tab Print Send
Ctrl Return Prev PAGE Next
Shift Home
Caps Lock
Line INS Char
Line DEL Char
Scrn CLR Line
Ins Repl
Enter

ASCII Keyboard Layout


F1 F2 F3 F4 F5 F6 F7 F8 F9 F10 F11 F12 F13 F14 F15 F16 SetUp Break
Esc Back Space Local Block
Tab Delete
Ctrl Return Line Feed
No Scroll Shift Home
Caps Lock
PF1 PF2 PF3 PF4
Enter

ANSI Keyboard Layout



Enhanced PC-Style Keyboard Layout

ASCII/ANSI Keyboard Cable and PCB Removal and Replacement

Tool required: No. 2 Phillips screwdriver

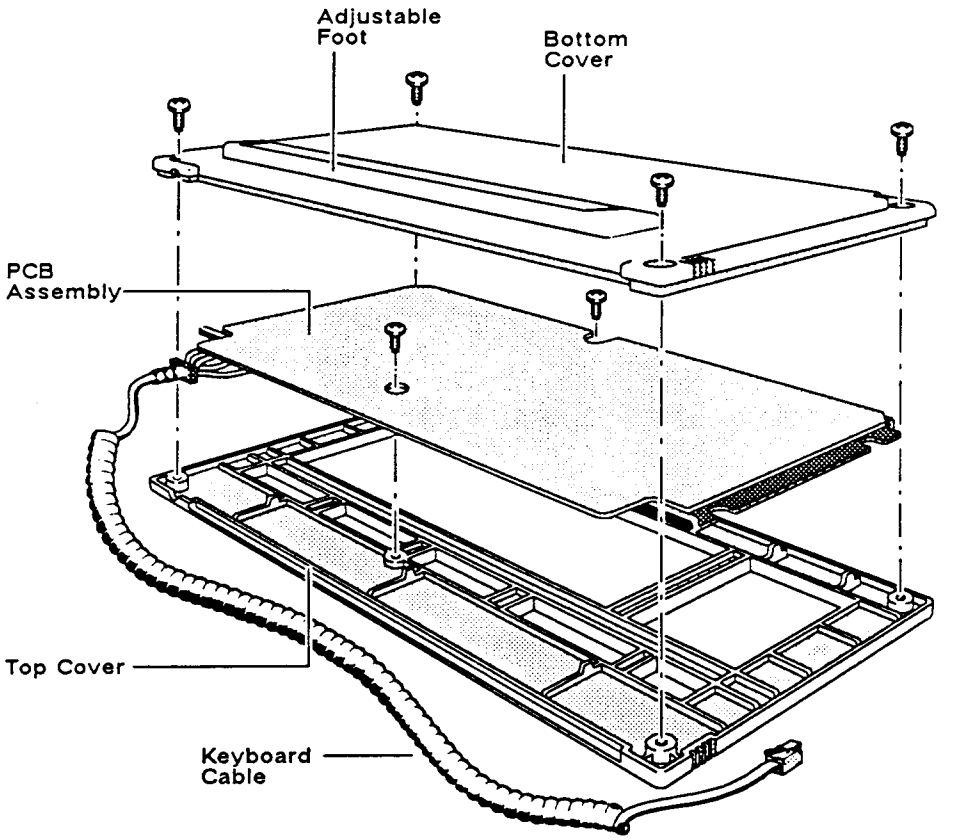
Perform the following steps to replace the keyboard cable and PCB (see Figure 1-3):

1 Turn the terminal off.

2 Press the keyboard cable connector tab and pull the cable from the keyboard socket on the side of the terminal.

3 Turn the keyboard over and remove the Phillips screws on the bottom of the keyboard. Remove the bottom cover.

Figure 1-3 ASCII/ANSI Keyboard Assembly



4 Remove the two Phillips screws, which hold the PCB to the top cover, on the bottom of the exposed keyboard PCB.

5 Lift the keyboard PCB out of the top cover. Turn it over.

6 Disconnect the keyboard cable from the keyboard cable connector on the PCB.

7 Connect the new keyboard cable to the keyboard cable connector on the new keyboard PCB.

8 Fit the keyboard PCB into the top cover, making sure to fit the keyboard cable into its special slot. Replace the two Phillips screws that secure the PCB to the top cover.

9 Replace the bottom cover and screws.

10 Plug the free end of the keyboard cable into the terminal keyboard socket.

Enhanced PC-Style Keyboard Cable and PCB Removal and Replacement

Tools required:

- No. 0 Phillips screwdriver
- No. 2 Phillips screwdriver

Perform the following steps to replace the keyboard cable and PCB (see Figure 1-4):

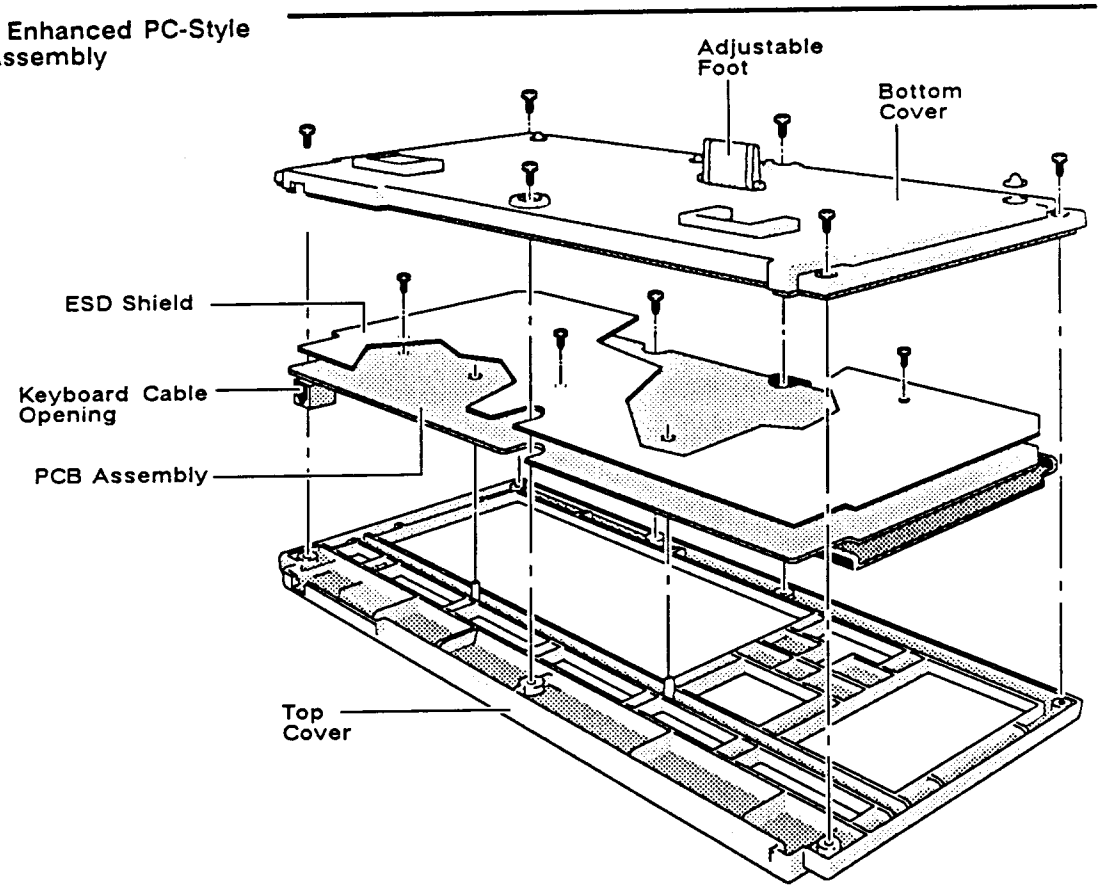
1 Turn off the terminal.

2 Unplug the keyboard cable from the keyboard.

3 Turn the keyboard over and remove the Phillips screws that attach the keyboard bottom cover to the keyboard.

4 Lift off the keyboard bottom cover.

Figure 1-4 Enhanced PC-Style Keyboard Assembly



5 Remove the No. 0 Phillips screw beneath the Spacebar that holds the keyboard top cover to the PCB assembly.

6 Unscrew the three No. 0 Phillips screws and washers that hold the keyboard ESD shield on the keyboard PCB.

7 Lift the PCB assembly out of the keyboard cover.

8 Cover the under side of the new keyboard PCB with the keyboard ESD shield. Replace the screws and washers. Tighten.

9 Fit the new keyboard PCB assembly back into the keyboard top cover.

10 Replace the No. 0 Phillips screw that holds the PCB assembly in place.

11 Reattach the bottom cover of the keyboard assembly.

12 Plug the keyboard cable into its socket on the side of the terminal.

TERMINAL MODULE ASSEMBLIES REMOVAL AND REPLACEMENT

This section describes removing and replacing the terminal enclosure, the fuse, the terminal PCB, the CRT, and the yoke assembly. It also describes how to discharge the CRT anode.

Terminal Enclosure Removal

Tool required: No. 2 Phillips screwdriver

⚠ **Warning** High voltage is present. Before removing the terminal enclosure, be sure to take all necessary precautions for working on high-voltage equipment.

Perform the following steps to remove the terminal enclosure (Figure 1-5):

1 Turn off the terminal.

2 Disconnect all cables from the terminal.

3 Rest the display face of the terminal on a padded nonscratch surface.

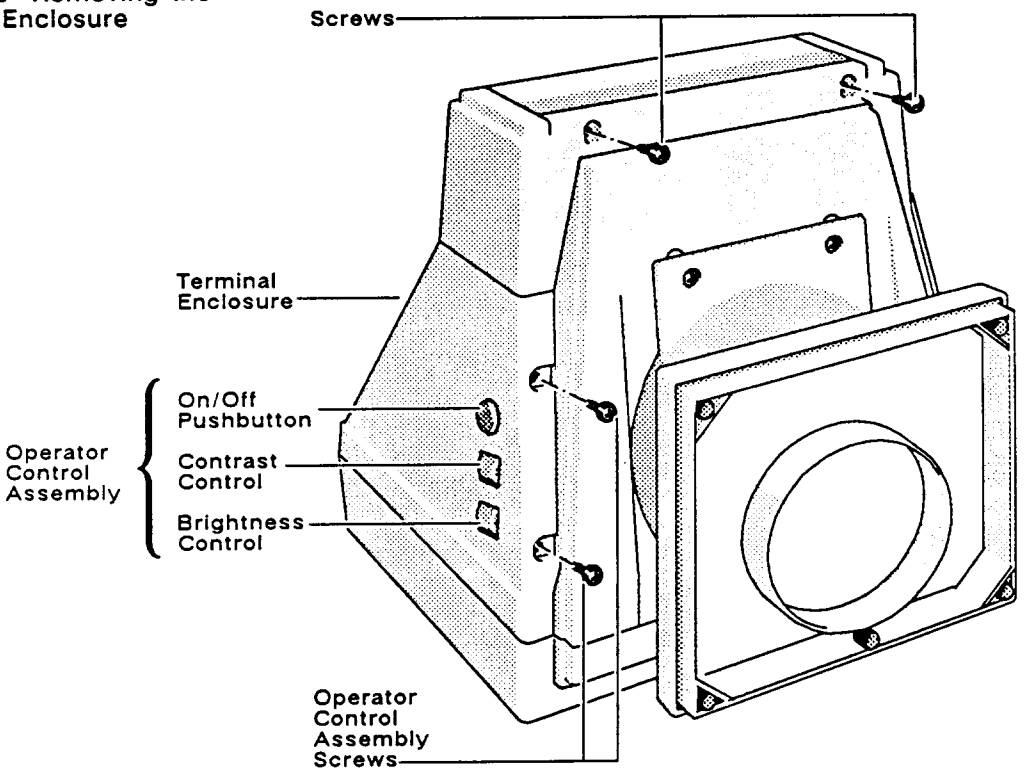
4 Remove the two screws holding the top cover in place (one on either side of the bottom rear of the chassis).

5 Remove the two screws securing the operator control assembly plate to the chassis.

6 Gently push the control assembly inward as far as possible to permit removal of the top cover without interference.

7 With one hand on either side of the terminal, simultaneously "slap" and pull the top cover up and off the unit.

Figure 1-5 Removing the Terminal Enclosure



Terminal Enclosure Replacement

Tool required: No. 2 Phillips screwdriver

Perform the following steps to replace the terminal enclosure:

1. Make sure the On/Off button is depressed to its On position.
2. With the terminal face on a nonscratch surface, position the enclosure over the chassis and seat it in the bezel.
3. Readjust the operator control assembly, making sure the control knobs don't rub the edges of the terminal enclosure.
4. Install the Phillips screws on the rear of the terminal enclosure. Tighten.
5. Install the two screws on the operator control assembly (on the underside of the terminal enclosure). Tighten.

Fuse Removal and Replacement

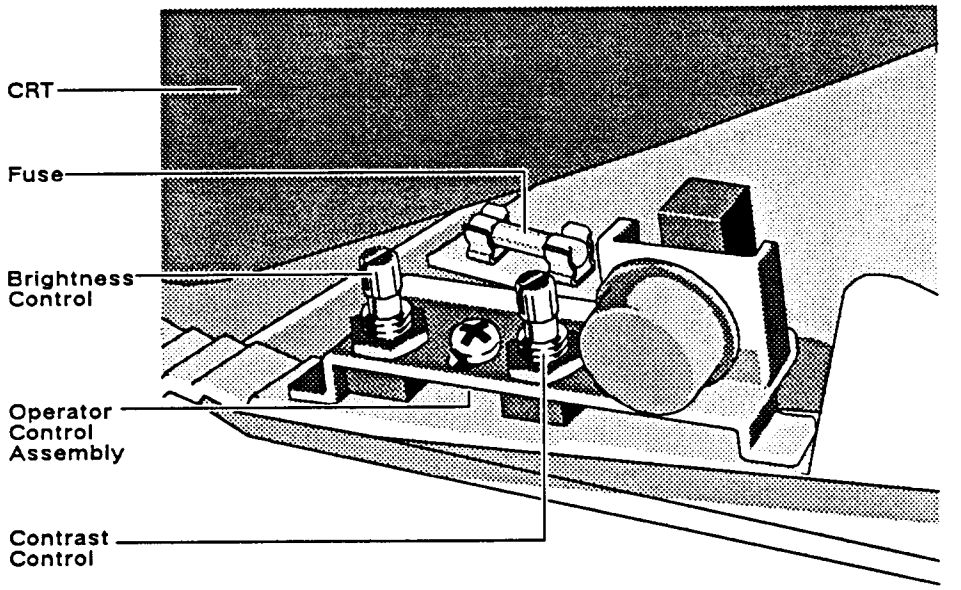
Perform the following steps to remove and replace the fuse, which is located under the CRT behind the operator control assembly (Figure 1-6).

1. Remove the terminal enclosure.
2. Pull off the brightness and contrast control knobs.
3. Replace the defective fuse with one of the same type and rating—2A/250V (slow blow).

4 Replace the control knobs.

5 Replace the terminal enclosure.

Figure 1-6 Fuse Location



Discharging the Anode

Tools required:

- Insulated flat-blade screwdriver
- Alligator clips

Perform the following steps to discharge the anode before removing the CRT (Figure 1-7):

1 Turn off the terminal.

2 Disconnect all cables from the terminal.

3 Remove the terminal enclosure.

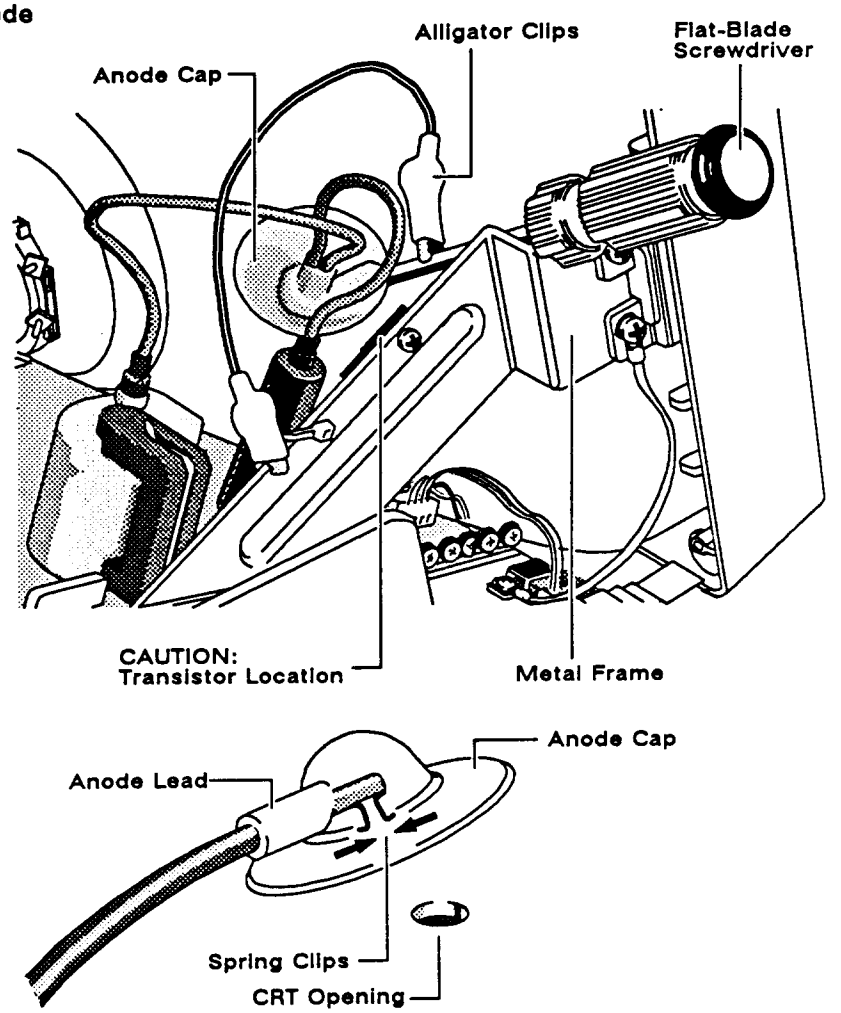
4 With alligator clips, ground the shaft of an insulated flat-blade screwdriver to the terminal's metal frame.

■ **Caution** To prevent damage when discharging the anode, avoid contact with the transistor, which is located on the terminal's metal frame.

5 Slip the blade between the anode cap and the anode lead. Touch the blade to the spring clips under the cap.

6 Remove the anode lead by pushing the two spring clips toward each other enough to clear the CRT opening (Figure 1-7).

Figure 1-7 Discharging the Anode



Perform the following steps to discharge the anode before installing a CRT:

1 Ground the shaft of an insulated flat-blade screwdriver against the terminal's metal frame or a convenient grounding pipe.

2 Touch the blade of the screwdriver to the anode.

3 Install the anode lead in the CRT opening.

Terminal PCB Removal

Tools required:

- No. 2 Phillips screwdriver
- Flat-blade screwdriver for discharging the anode
- Alligator clips for discharging the anode

Perform the following steps to remove the terminal PCB (Figures 1-8 and 1-9):

1 Turn off the terminal.

2 Disconnect all cables from the terminal.

⚠ **Warning** High voltage is present. Before removing the terminal enclosure, be sure to take all necessary precautions for working on high-voltage equipment.

3 Remove the terminal enclosure (see "Removing the Terminal Enclosure" for instructions).

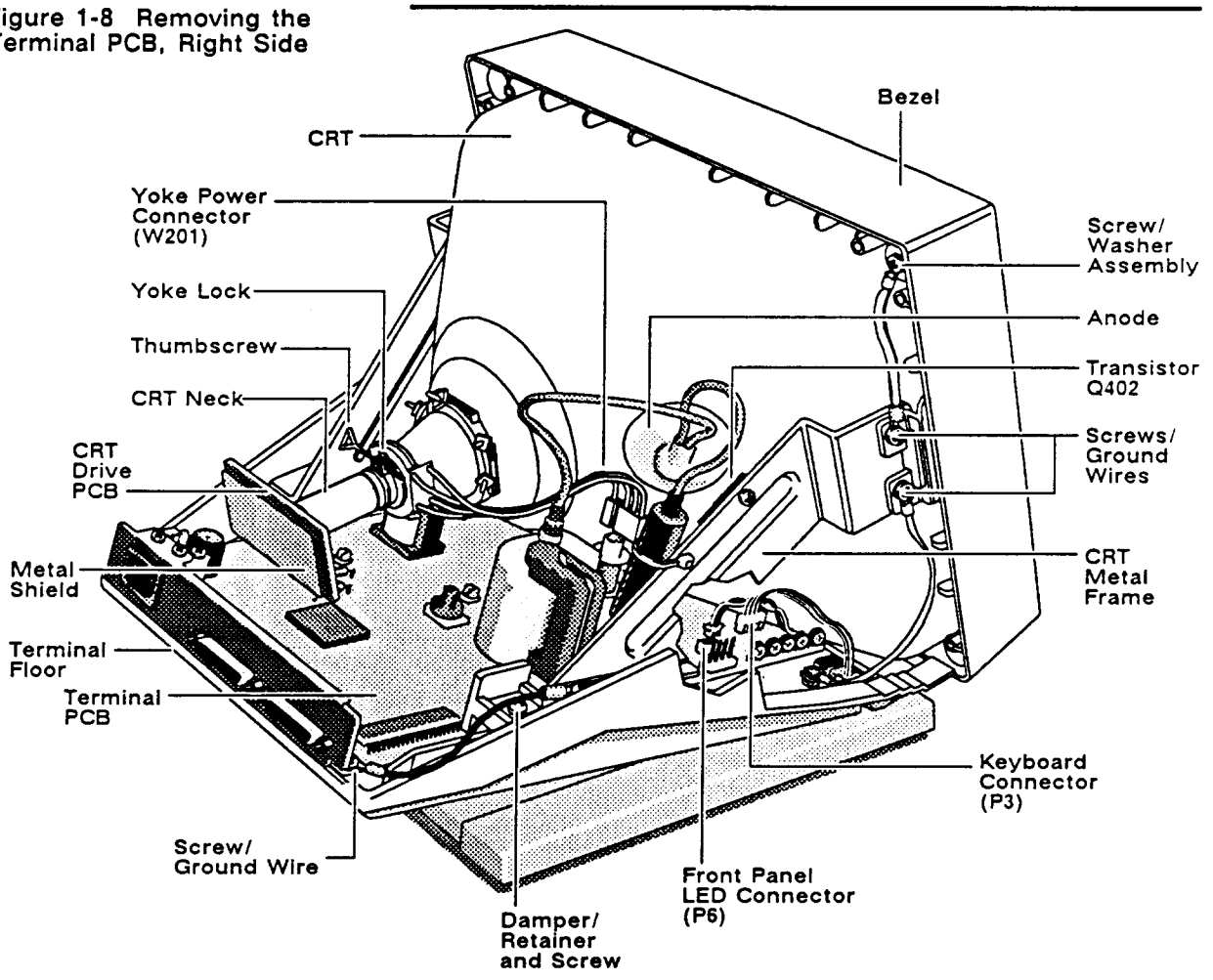
4 Discharge the anode (see "Discharging the Anode" for instructions).

5 Disconnect the anode lead.

⚠ **Warning** Handle the CRT neck carefully. If you break it, flying glass can injure anyone within a radius of ten feet.

6 Cut, as necessary, any tie-wraps.

Figure 1-8 Removing the Terminal PCB, Right Side



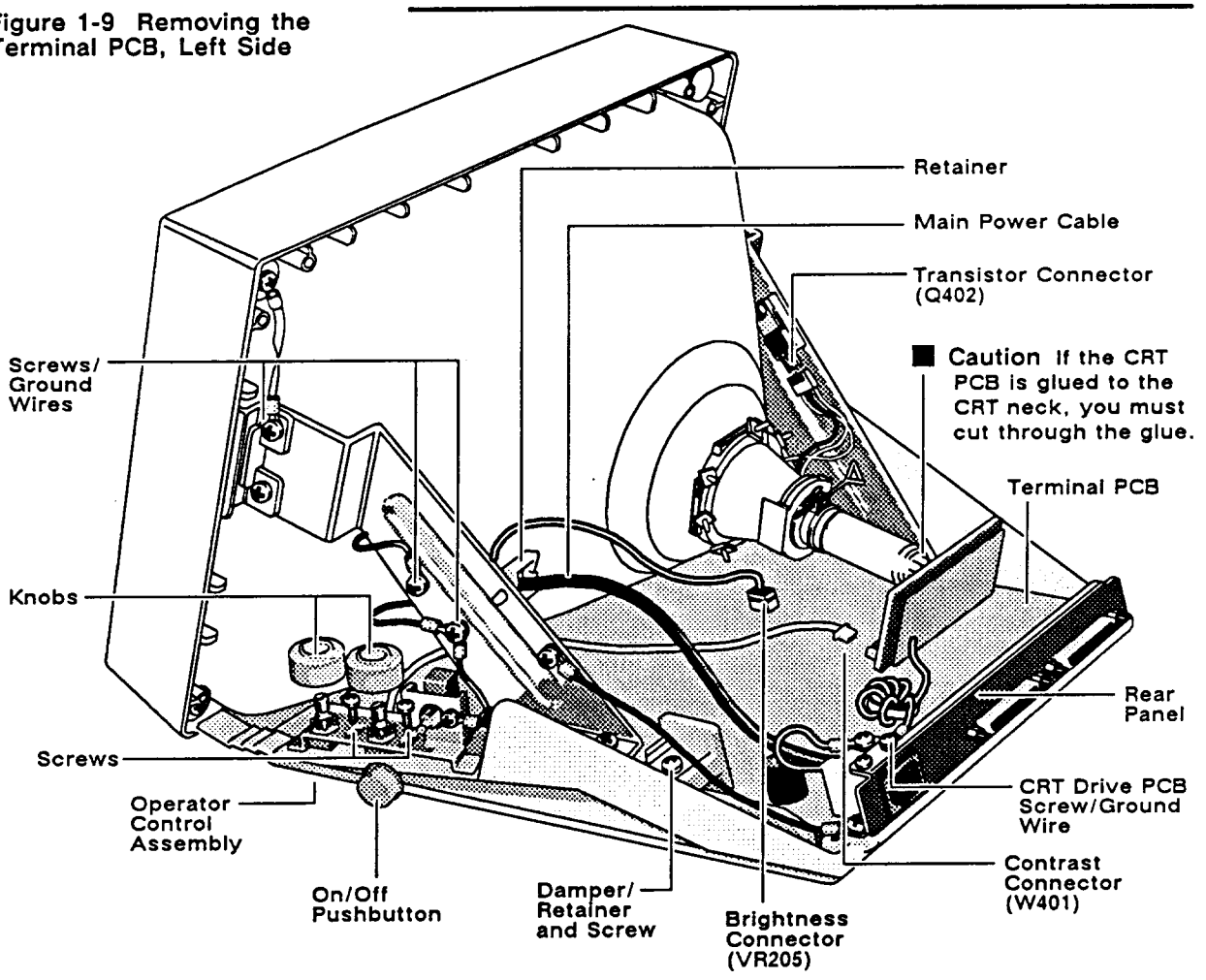
7 Disconnect the following:
- Four-pin keyboard connector (P3)
- Two-pin front-panel LED connector (P6)
- Four-pin yoke power connector (W201)
- Three-pin brightness connector (VR205)
- Transistor connector (Q402)
- Three-pin contrast connector (W401)

8 Remove the screws securing the following ground wires:
- From the metal shield on the CRT drive PCB to the rear panel
- From the operator control assembly/AC power line to the metal frame above the operator control assembly

9 Carefully pull the CRT drive PCB from the CRT neck.

■ **Caution** If the CRT PCB is glued to the CRT neck, you must cut through the glue with a sharp blade.

Figure 1-9 Removing the Terminal PCB, Left Side



10 Pull the operator control knobs and the On/Off pushbutton off their posts.

11 Remove the two screws securing the operator control assembly to the terminal floor.

12 Remove the two ground wires and Phillips screws on the rear corners of the terminal PCB.

13 Remove the damper/retainer and screw from each side of the terminal PCB.

14 Remove the main power cable from its retainer above the operator control assembly.

15 Carefully pull the terminal PCB out the rear of the terminal.

Terminal PCB Replacement

Tools required:

- No. 2 Phillips screwdriver
- Flat-blade screwdriver for discharging the anode
- Alligator clips for discharging the anode

Perform the following steps to replace the terminal PCB:

1 Position the terminal PCB approximately one-third of the way in on the terminal floor.

2 Connect the four-pin yoke power connector W201 to the terminal PCB.

3 Slide the terminal PCB the remaining distance in on the terminal floor.

4 Reinstall the damper/retainer and screw on each side of the terminal PCB.

5 Reinstall the two ground wires and Phillips screws on the rear corners of the terminal PCB.

6 Install the screw that secures the operator control assembly/AC power line ground wires to the metal frame above the operator control assembly.

7 Install the two Phillips screws on the operator control assembly. Tighten loosely enough to allow adjustment of the assembly.

8 Install the operator control knobs and the On/Off pushbutton on the appropriate posts.

9 Reconnect the following:

- Two-pin front-panel LED connector (P6)
- Four-pin keyboard connector (P3)
- Three-pin brightness connector (VR205)
- Transistor connector (Q402)

⚠ **Warning** Handle the CRT neck carefully. If you break it, flying glass can injure anyone within a radius of ten feet.

10 Reinstall the CRT drive PCB on the CRT neck and reconnect the three-pin contrast connector (W401).

11 Reinstall the ground wire and screw from the CRT drive PCB to the rear panel.

12 Replace the main power cable in its retainer on the metal frame.

13 Discharge the anode (see "Discharging the Anode").

14 Reconnect the anode lead.

15 Install the terminal enclosure after adjusting the position of the operator control assembly (if necessary) and tightening its screws.

16 Reconnect the keyboard.

CRT Removal

Tools required:

- No. 2 Phillips screwdriver
- Flat-blade screwdriver for discharging the anode
- Alligator clips for discharging anode

Perform the following steps to remove the CRT (see Figures 1-8 and 1-9):

1 Turn off the terminal and remove all communications cables.

2 Remove the terminal enclosure.

3 Discharge the anode.

4 Disconnect the anode lead.

5 Cut, as necessary, any tie-wraps.

6 Disconnect the two-pin front-panel LED connector (P6) from the terminal PCB.

7 Remove the screw securing the DAG wire/ground from the CRT to the metal frame.

8 Disconnect the four-pin yoke power connector (W201) from the terminal PCB.

⚠ **Warning** Handle the CRT carefully. If you break it, flying glass can injure anyone within a radius of ten feet.

9 Remove the screw from the ground wire between the CRT drive PCB and the rear panel.

10 Carefully pull the CRT drive PCB from the CRT neck.

■ **Caution** If the board is glued to the CRT neck, carefully cut the glue with a sharp blade.

11 Remove the four screws (two on each side) securing the CRT to the metal frame.

12 Pull the terminal floor and its attached metal frame away from the CRT and the bezel.

13 Remove the four Phillips screw/washer assemblies (two have ground wires attached) securing the CRT to the bezel.

14 Pull the CRT away from the bezel.

CRT Replacement

Tools required:

- No. 2 Phillips screwdriver
- Flat-blade screwdriver for discharging anode
- Alligator clips for discharging anode

Perform the following steps to replace the CRT:

1 Discharge the anode on the new CRT (see "Discharging the Anode).

⚠ **Warning** If you are replacing the same CRT/yoke assembly, you still need to discharge the anode.

2 Install the CRT in the bezel.

3 Connect the anode lead.

4 Install the four Phillips screw/washer assemblies (two have ground wires attached) that secure the CRT to the bezel.

5 Slip the terminal floor with its attached metal frame into the bezel.

6 Install two screws on each side of the CRT, securing the metal frame to the bezel. Be sure to attach the ground wires with the top screws on each side.

⚠ **Warning** Handle the CRT carefully. If you break it, flying glass can injure anyone within a radius of ten feet.

7 Install the CRT drive PCB on the CRT neck.

8 Reconnect the following:

- Two-pin front-panel LED connector (P6)
- Four-pin yoke power connector (W201)

8 Install the screw securing the DAG wire/ground from the CRT to the metal frame.

10 Install the terminal enclosure.

Yoke Assembly Removal

Tools required: None

Perform the following steps to remove the yoke:

1 Turn off the terminal.

2 Remove all cables from the terminal.

3 Remove the terminal enclosure.

4 Disconnect the three-pin contrast connector (W401) and the ground from the CRT drive PCB to the rear panel.

■ **Caution** If the board is glued to the CRT neck, carefully cut the glue with a sharp blade.

5 Carefully pull the CRT drive PCB from the CRT neck.

6 Disconnect the yoke power connector (W201) from the terminal PCB.

7 Loosen the yoke lock on the neck of the CRT by turning the thumbscrew counterclockwise (see Figure 1-8).

⚠ **Warning** Handle the CRT neck carefully. If you break it, flying glass can injure anyone within a radius of ten feet.

8 Gently remove the yoke by pulling it off the CRT neck.

Yoke Assembly Replacement

Tools required: None

⚠ **Warning** Handle the CRT neck carefully. If you break it, flying glass can injure anyone within a radius of ten feet.

Perform the following steps to replace the yoke assembly:

1 Gently position the yoke on the neck of the CRT.

2 Tighten the yoke lock thumbscrew carefully.

■ **Caution** Too much thumbscrew pressure will crack the CRT neck.

3 Install the CRT drive PCB on the CRT neck.

4 Reconnect the following:
- Yoke power connector (W201)
- Three-pin contrast connector (W401)
- Ground from the CRT drive PCB to the rear panel

5 Reinstall the terminal enclosure.

2 Troubleshooting

BEFORE YOU START

Read the following safety information carefully before you attempt to troubleshoot your unit.

Safety

This terminal contains high voltage. Don't attempt to service the terminal without taking the following precautions:

- Turn the terminal off and disconnect the power cable.
- Remove jewelry from your hands and wrists.
- Avoid wearing clothing made of synthetic fabrics.
- Use insulated or nonconductive tools.
- Handle circuit boards only by their edges.
- Don't reconnect the power cable or turn the terminal on unnecessarily while the terminal enclosure is removed.
- Whenever you connect or disconnect the anode from the anode lead, make sure to discharge the anode as directed in Section 1.

⚠ **Warning** The CRT/yoke assembly has high voltages. Only qualified service personnel should adjust it.

- If you need to remove or replace the CRT/yoke assembly, remember that it can implode if you drop it or break the neck. The flying glass can injure anyone within a radius of ten feet.
- Always use the manufacturer's replacement components. Especially critical components as indicated on the circuit schematics should not be replaced with any component other than the manufacturer's. Where a short circuit has occurred, replace those components that indicate evidence of overheating.

Required Tools

Before you start to repair the terminal, make sure you have the following tools and materials:

- No. 2 Phillips screwdriver
- 3/16-inch flat-blade screwdriver
- Digital multimeter (DMM) or a voltmeter
- Test connectors for the MAIN and AUX1 ports
- Nonconductive video alignment tool
- 100-MHz oscilloscope

PRIMARY TROUBLESHOOTING PROCEDURES

Begin troubleshooting by preparing the terminal properly and running the power-on self-test and the diagnostic self-test.

Diagnostic Self-Test

The terminal diagnostic self-test starts in setup mode. This procedure includes communications circuitry tests, memory read/write tests, EPROM tests, and nonvolatile RAM tests. Two special test connectors allow the diagnostic test to function. After starting, the diagnostic test will run until you terminate it. If the test detects an error, an error code and message display on the screen. Error codes are defined in Table 2-1. See Figure 3-4 in Section 3 for component locations on the terminal PCB.

Table 2-1 Error Codes

Code	Failure Message	Location
0	Character RAM Chip	U3
1	Attribute RAM Chip	U9
2	Font RAM	U2
P	Code PROM Checksum	U5
K	Setup Lost (Battery)	BATT1
d	AUX1 Port D0, D1-ACK	U11 or U12
b	AUX1 Port D2, D3-BUSY	U11 or U12
C	AUX1 Port D4, D5-PE	U11 or U12
a	AUX1 Port D6, D7-ERROR	U11 or U12
A	MAIN Port RTS-CTS	U10 or U7
c	MAIN Port DTR-DCD	U10 or U7
X	MAIN Port TxD-RxD	U10 or U7

Follow these steps to run the diagnostic self-test:

1 Turn off the terminal. Unplug it from its AC power source and disconnect any communications cables.

2 Attach loopback diagnostic test connector LB1 to the MAIN port and the EVEN or ODD loopback diagnostic test connector to the AUX1 port on the terminal's rear panel. Loopback connector pin numbers and signals for the ports are shown in Table 2-2.

3 Plug in the terminal and turn it on. The test screen fills with a "walking" RAM character pattern for about 90 seconds, then the screen changes to a "walking" attribute pattern.

☐ **Note** To fully test the terminal, let the diagnostic self-test run five minutes.

4 If the test stops, the terminal beeps, and a letter or number appears on the screen, refer to Table 2-1 for an interpretation of the error codes before proceeding to the appropriate troubleshooting flowchart.

5 After completing the test, turn the terminal off. Remove the test connectors and reattach the communications cables.

Table 2-2 Loopback Test Connector Pin Assignments

Loopback Port	Pin	Signal
MAIN	2-3	TXD → RXD
	4-5	RTS → CTS
	8-20	DCD → DTR
AUX1 (Even Parallel)	2-10	D0 → ACK
	4-11	D2 → BUSY
	6-12	D4 → PE
	8-15	D6 → ERROR
	1-LED-17	STB → Ground
AUX1 (Odd Parallel)	3-10	D1 → ACK
	5-11	D3 → BUSY
	7-12	D5 → PE
	9-15	D7 → ERROR
	1-LED-17	STB → Ground

Troubleshooting Quick Reference Guide

Table 2-3 is a troubleshooting quick reference guide. Once you discover the major symptoms, this table can quickly direct you to the most likely problem area. However, don't automatically replace the suggested modules until you've studied the problem and checked related details in the troubleshooting flowcharts.

Table 2-3 Module-Level Troubleshooting Quick Reference Guide

	Possible Problem Area						
Symptom	Terminal PCB	CRT/ Yoke	Keyboard Cable	Setup Parameter	Comm. Cable	Adjust-ment	Test Conn.
No video	■	■				■	
Poor display	■					■	
Fails diagnostic test	■						■
No keyboard response	■		■	■	■		
Communication problems/host	■			■	■		

Table 2-4 provides suggestions for actions to take depending on the symptom exhibited. The flowcharts (Figures 2-1 through 2-13) give detailed directions and waveforms, where applicable, for corrective actions.

Table 2-4 Troubleshooting by Symptom

Symptom	Possible Problem Area
Single vertical line on the display	1. Power supply voltages: +5, +12, -12, +15, +30, and +55 2. Dot clock circuitry 3. Custom IC H-Sync 4. Horizontal control circuitry 5. Yoke connection and horizontal signals
Single horizontal line on the display	1. Power supply voltages: +5, +12, -12, +15, +30, and +55 2. Dot clock circuitry 3. Custom IC V-Sync 4. Vertical controller circuitry 5. Yoke connection and vertical signals
No video	1. Power cord, power switch, and fuse 2. Operator brightness and contrast control knobs setting 3. Power supply voltages: +5, +12, -12, +15, +30, and +55 4. Reset circuitry 5. Dot clock circuitry 6. Custom IC H-Sync, V-Sync, video 0, and video 1 7. Horizontal controller circuitry 8. Vertical controller circuitry 9. CRT driver 10. Voltage entering the yoke
Dim video	1. Operator brightness and contrast control knobs setting 2. Power supply voltages: +5, +12, -12, +15, +30, and +55 3. VR204 setting (see Section 3, Adjustments and Alignments) 4. Adjustment of VR402 on the CRT driver (see Section 3, Adjustments and Alignments)
No beep	1. Power cord and switch, fuse 2. +5V and +12V power supply voltages 3. Reset circuitry 4. Beeper circuitry
No keyboard response	1. Power supply voltages: +5, +12, -12, +15, +30, and +55 2. Keyboard connector 3. Custom IC U4 4. Keyboard buffer U13 5. Keyboard PCB 6. 8032 IC U6
Raster but no video	1. Operator brightness and contrast control knobs setting 2. Power supply voltages: +5, +12, -12, +15, +30, and +55 3. Custom IC video signal 4. CRT driver IC301 and Q402
Communication problems	1. Power cord and communications cables 2. Setup information incorrect for the host computer's requirements 3. Run the diagnostic test and look for error codes
Vertical linearity	1. Power supply voltages: +5, +12, -12, +15, +30, and +55. 2. Custom IC V-Sync 3. Vertical adjustment VR303* 4. Vertical controller circuitry*

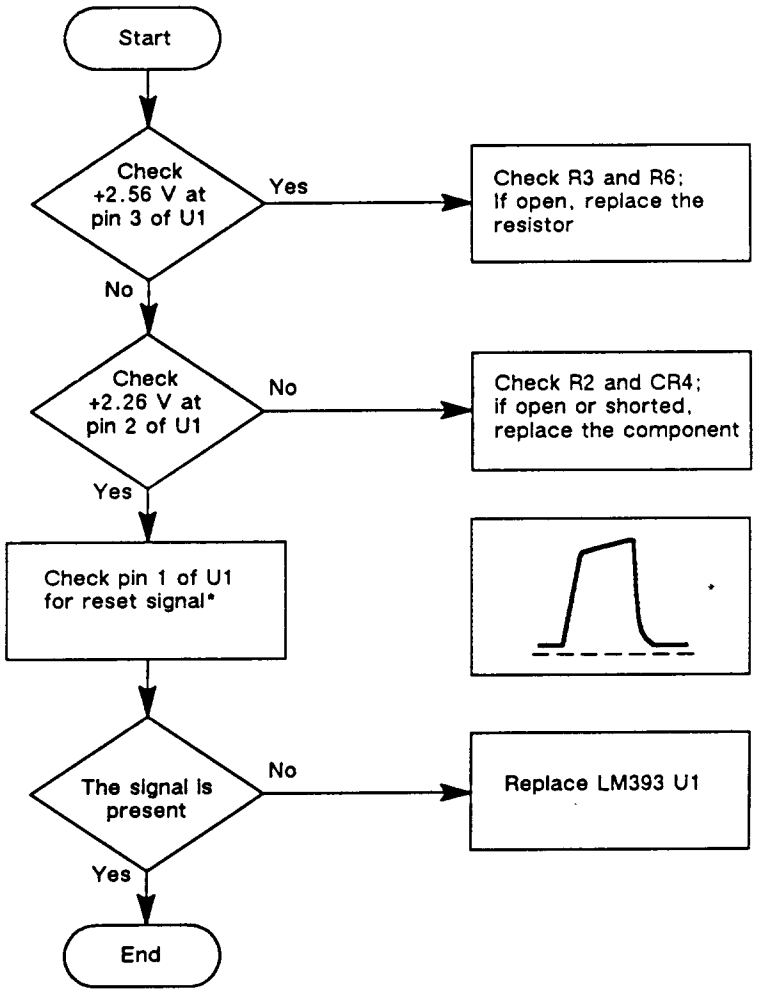
* See Table 3-2 for an illustration of this problem area.

TROUBLESHOOTING FLOWCHARTS

Match the problem symptom with the suggested solutions in the troubleshooting flowcharts (Figures 2-1 through 2-13). The schematics in Section 6 will help you interpret the flowcharts.

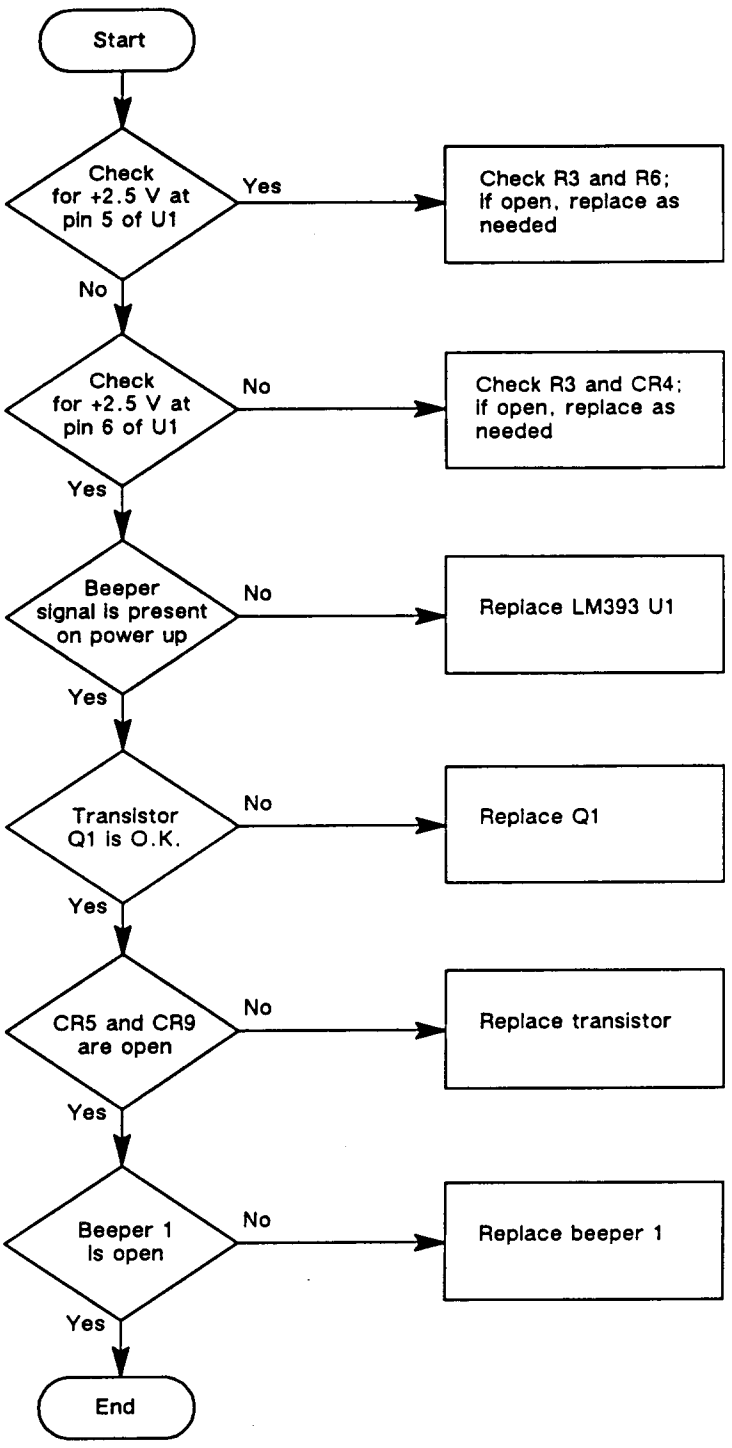
☐ **Note** All flowcharts are based on terminal operation in 60-Hz mode.

Figure 2-1 Reset Circuitry IC U1 Flowchart



* This signal is only generated at power on. To observe it, set your oscilloscope to a very slow sweep rate (5 ms/sweep), put a probe on Pin 1, then turn on power. Observe a ≈1 ms pulse.

Figure 2-2 Beeper Circuitry Flowchart



ure 2-3 8032 IC U6
owchart

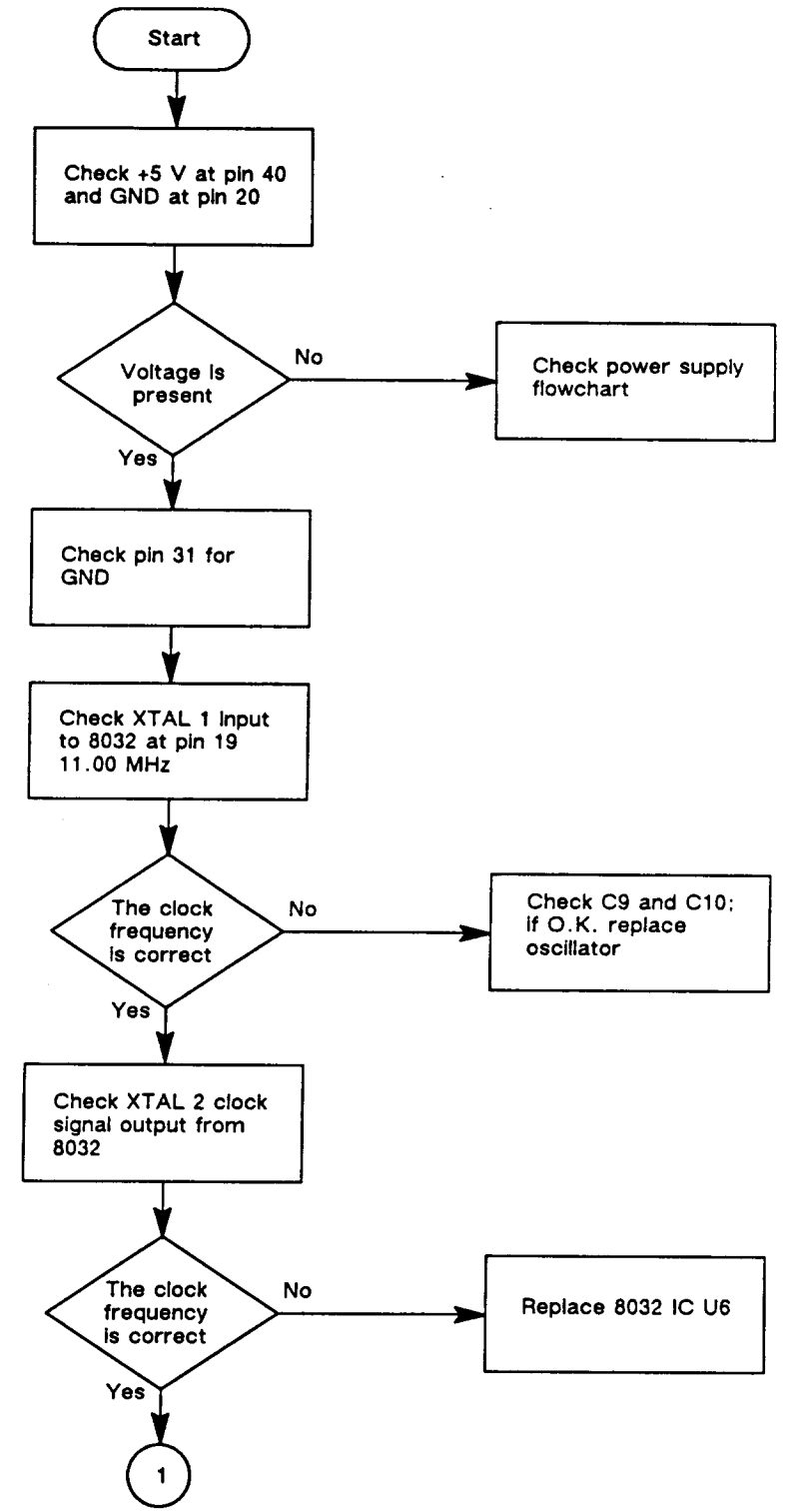

Start
Check +5 V at pin 40 and GND at pin 20
Voltage is present
No
Check power supply flowchart
Yes
Check pin 31 for GND
Check XTAL 1 input to 8032 at pin 19 11.00 MHz
The clock frequency is correct
No
Check C9 and C10; if O.K. replace oscillator
Yes
Check XTAL 2 clock signal output from 8032
The clock frequency is correct
No
Replace 8032 IC U6
Yes
1

Figure 2-3 8032 IC U6 Flowchart, Continued

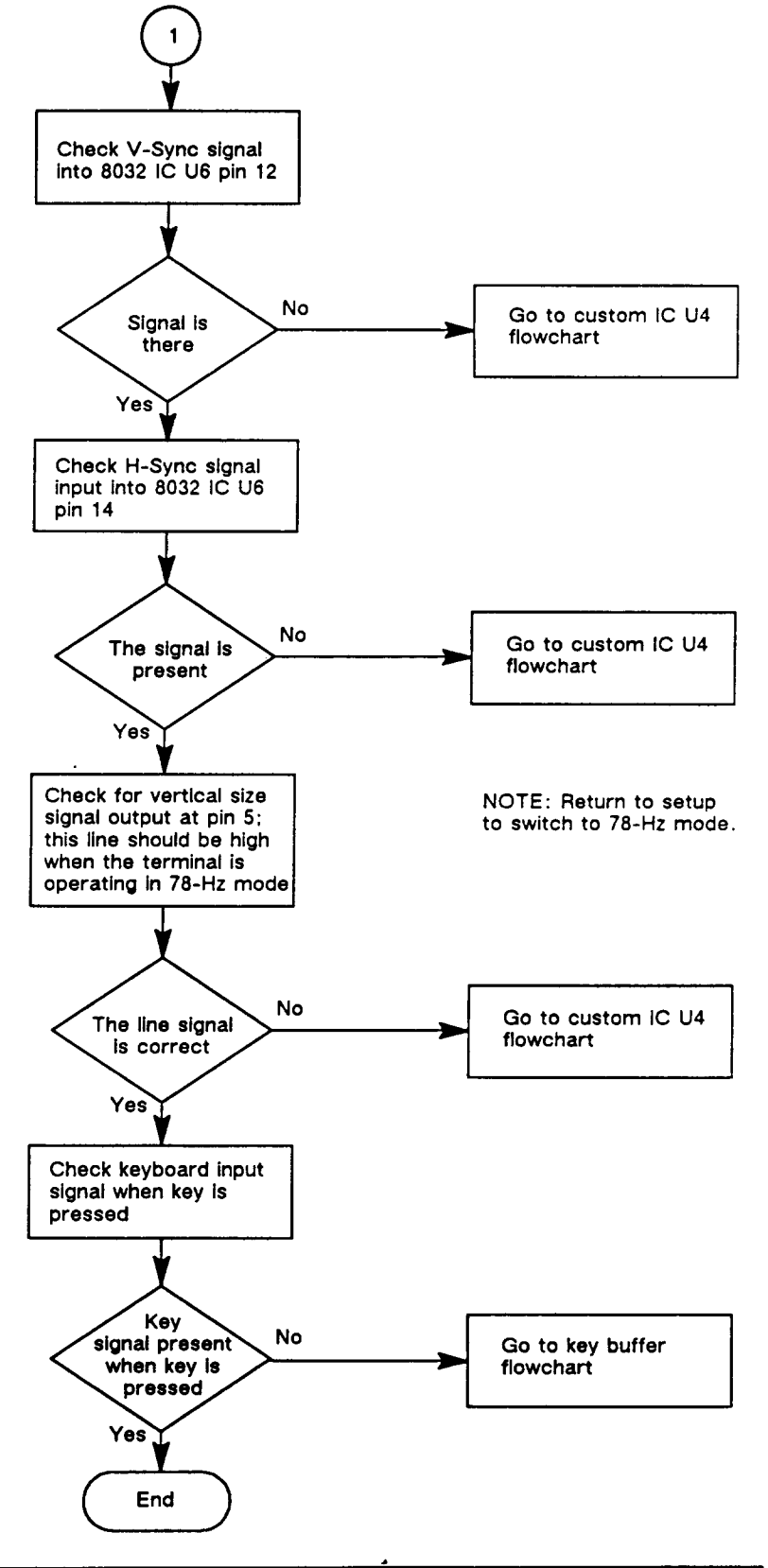

1
Check V-Sync signal into 8032 IC U6 pin 12
Signal is there
No
Go to custom IC U4 flowchart
Yes
Check H-Sync signal input into 8032 IC U6 pin 14
The signal is present
No
Go to custom IC U4 flowchart
Yes
Check for vertical size signal output at pin 5; this line should be high when the terminal is operating in 78-Hz mode
NOTE: Return to setup to switch to 78-Hz mode.
The line signal is correct
No
Go to custom IC U4 flowchart
Yes
Check keyboard input signal when key is pressed
Key signal present when key is pressed
No
Go to key buffer flowchart
Yes
End

Figure 2-4 Dot Clock IC U8 Flowchart

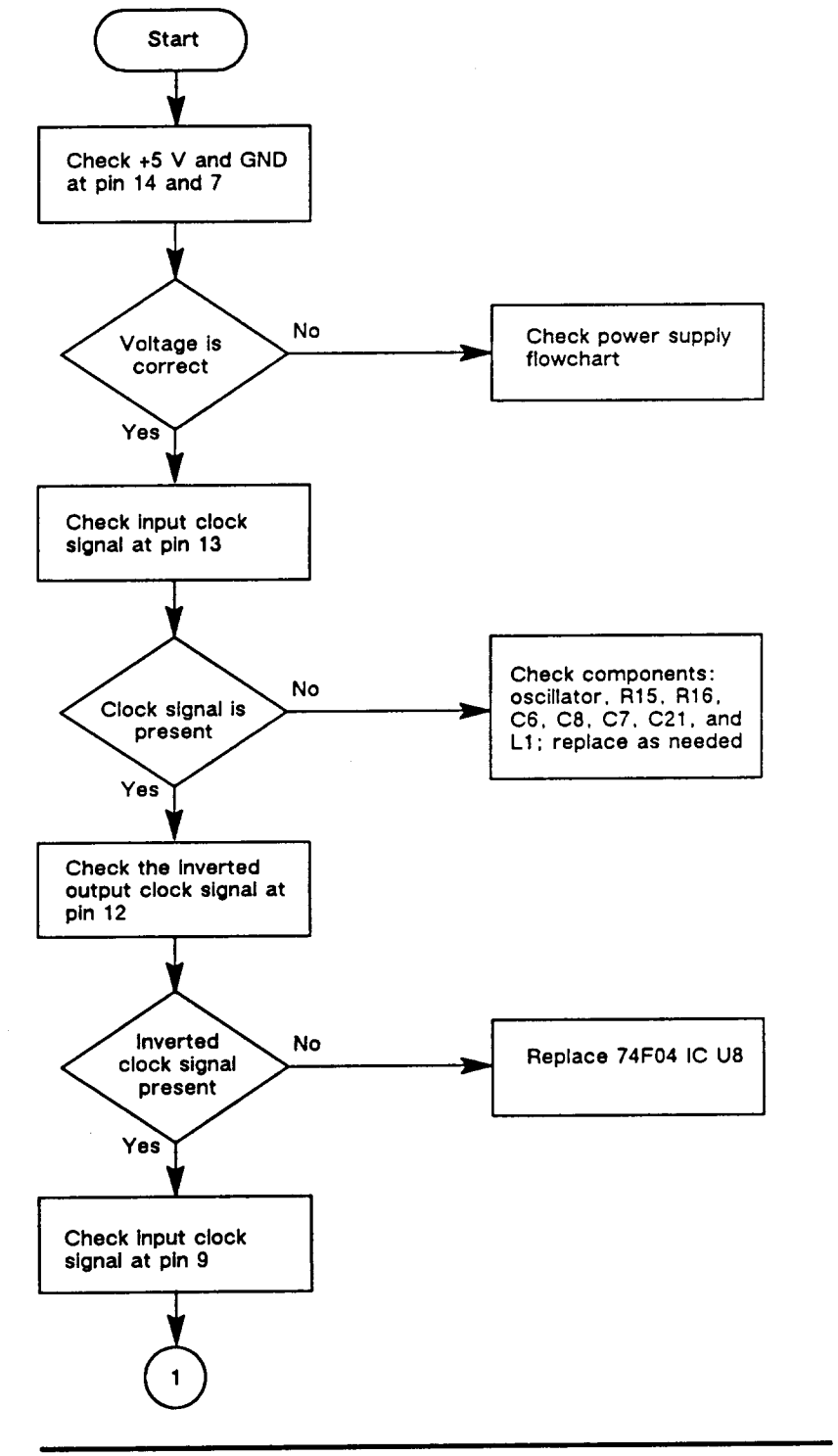

Start
Check +5 V and GND at pin 14 and 7
Voltage is correct
No
Check power supply flowchart
Yes
Check input clock signal at pin 13
Clock signal is present
No
Check components: oscillator, R15, R16, C6, C8, C7, C21, and L1; replace as needed
Yes
Check the inverted output clock signal at pin 12
Inverted clock signal present
No
Replace 74F04 IC U8
Yes
Check input clock signal at pin 9
1

Figure 2-4 Dot Clock IC U8 Flowchart, Continued

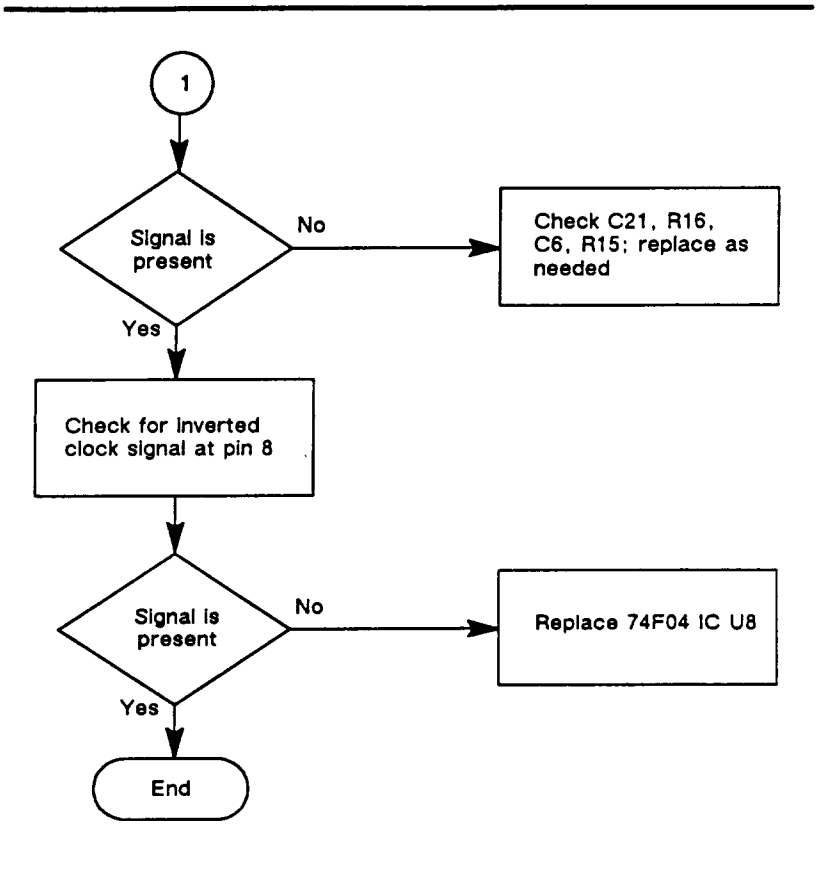
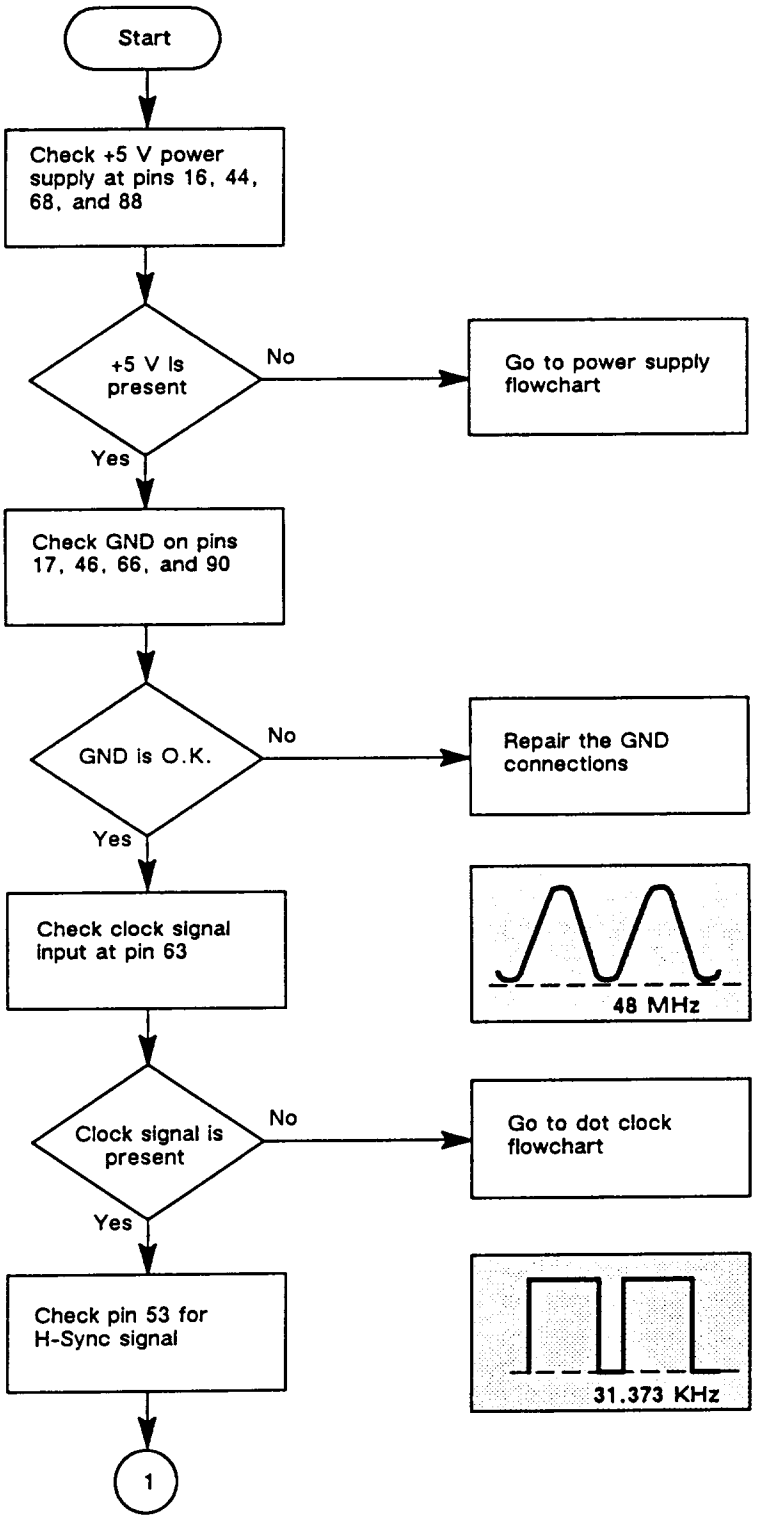
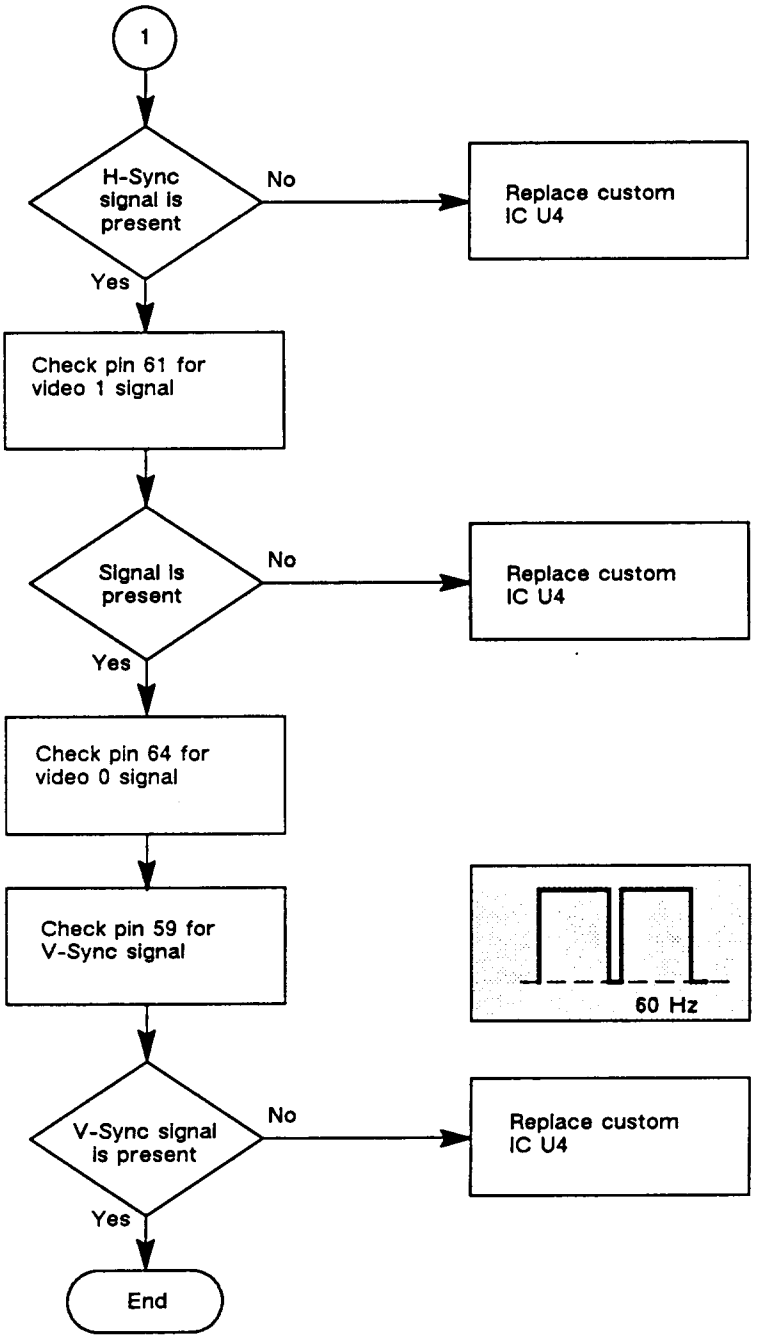


Figure 2-5 Custom IC U4 Flowchart



NOTE: If the frequency is incorrect, see the 8032 IC U6 flowchart.

Figure 2-5 Custom IC U4 Flowchart, Continued



NOTE: If the frequency is incorrect, see the 8032 IC U6 flowchart.

Figure 2-6 Key Buffer IC U13 Flowchart

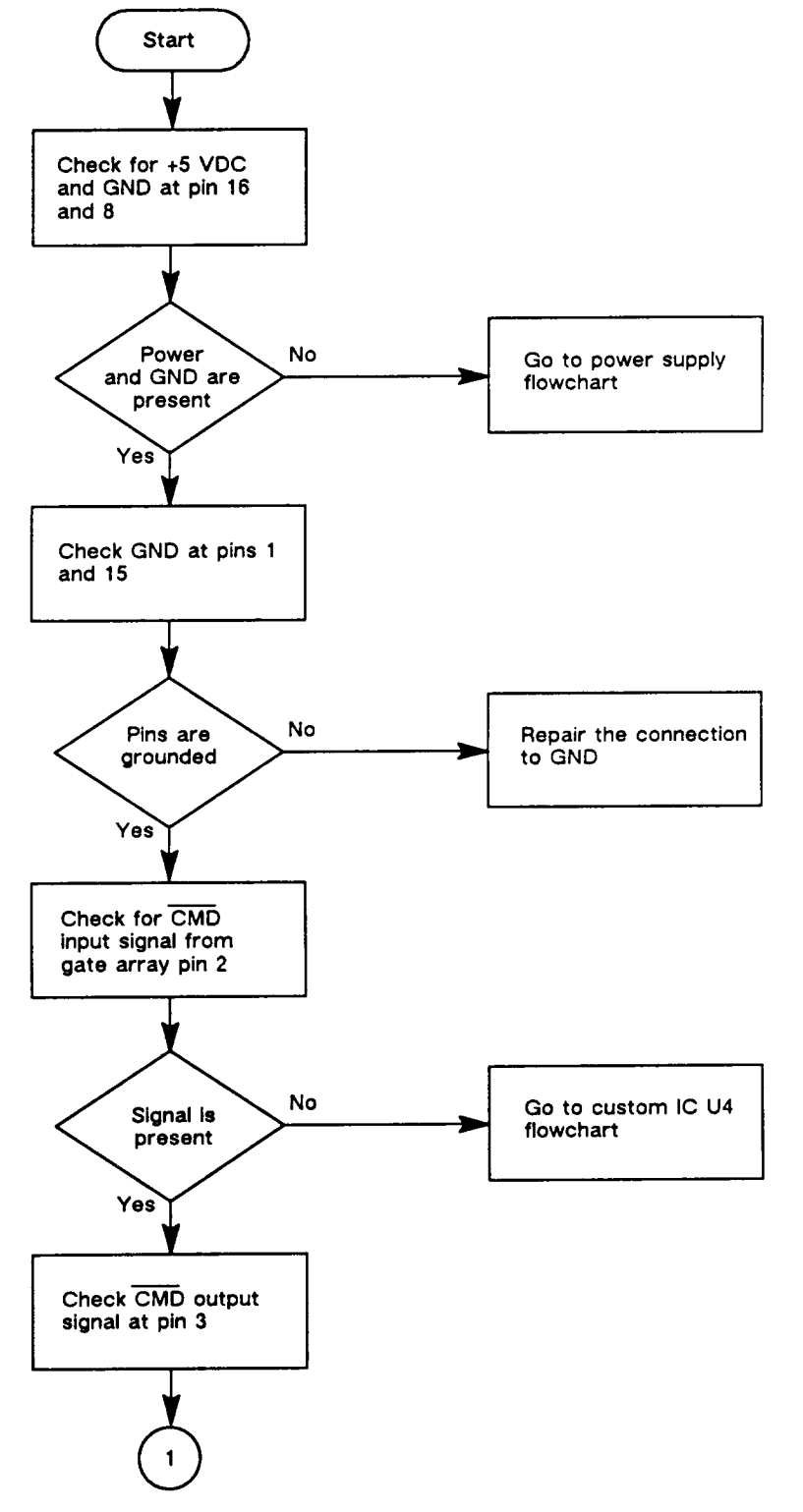


Figure 2-6 Key Buffer IC U13 Flowchart, Continued

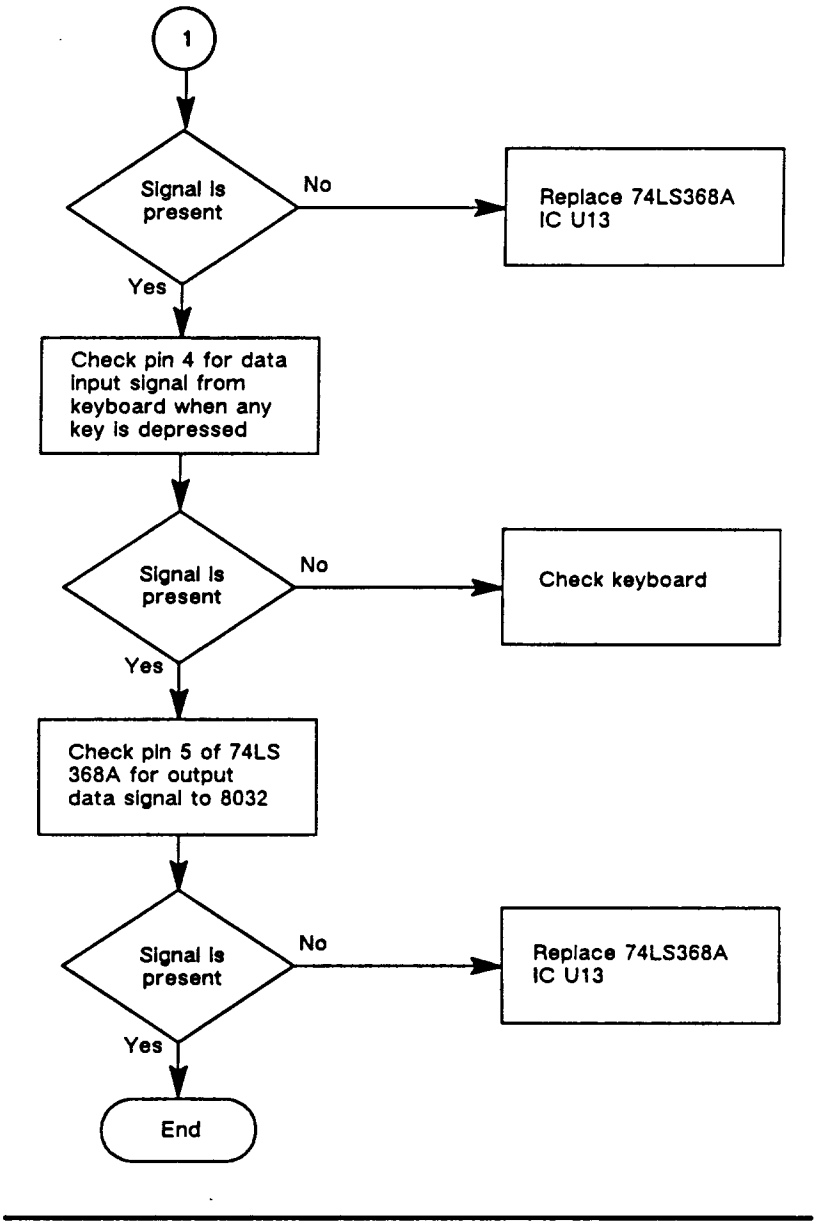


Figure 2-7 Power Supply Line Filter Flowchart

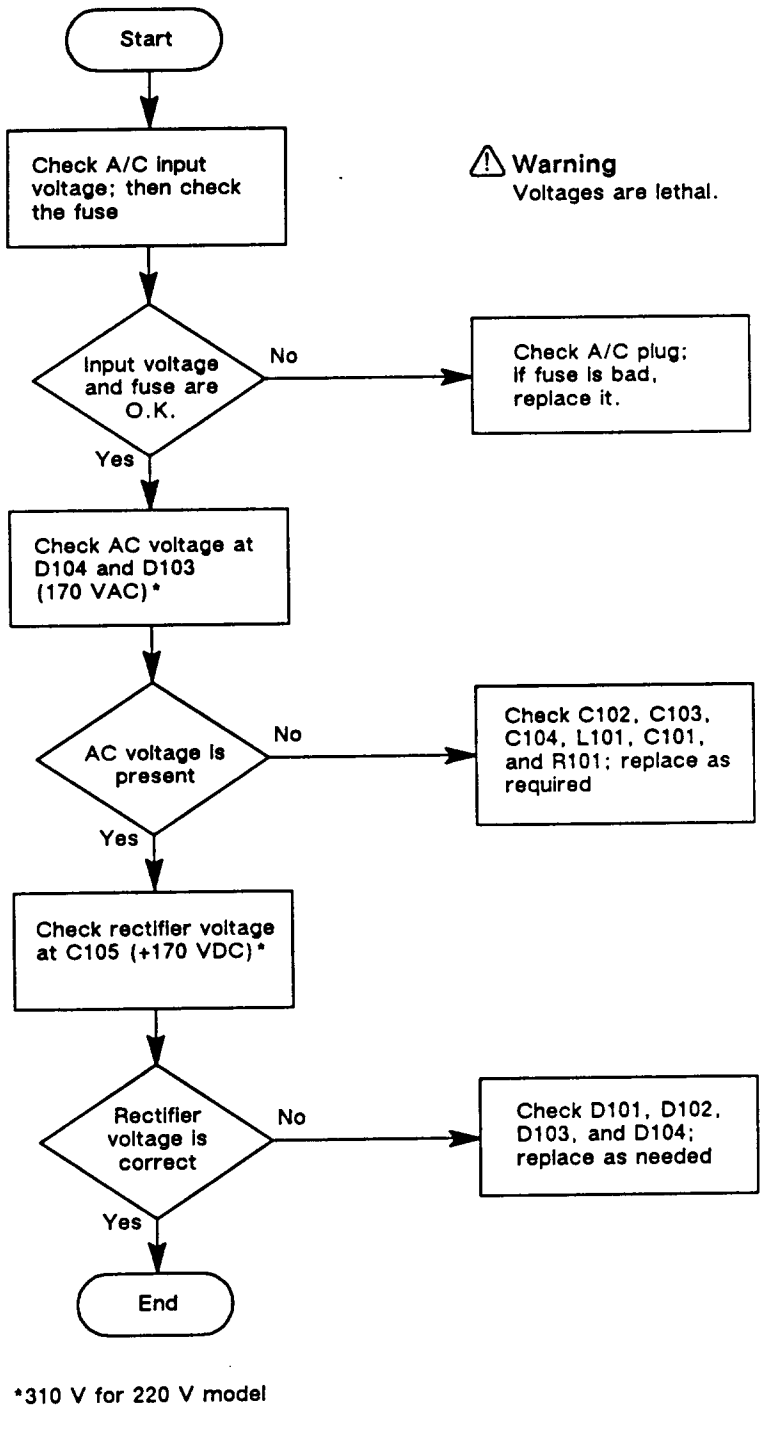
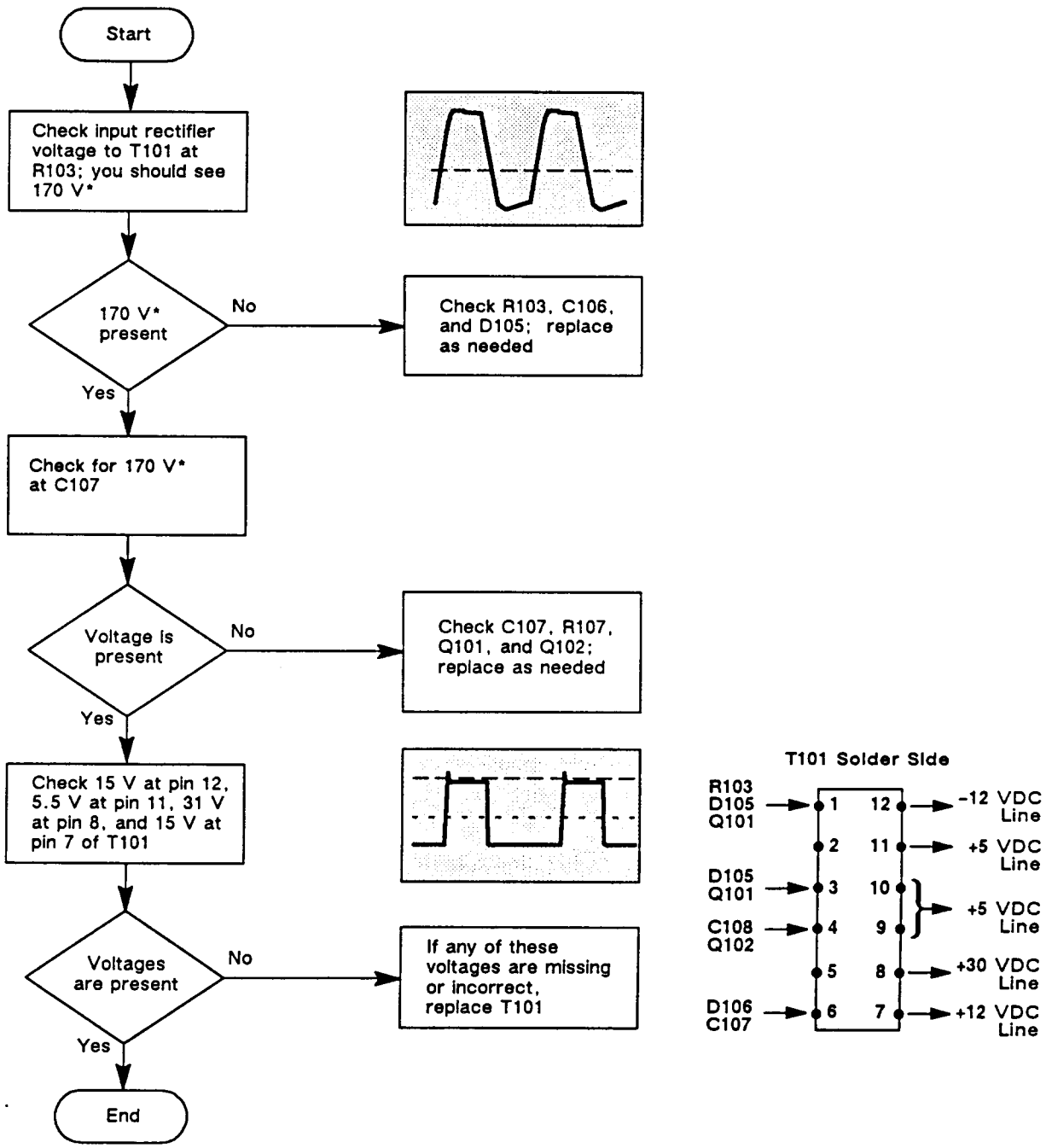
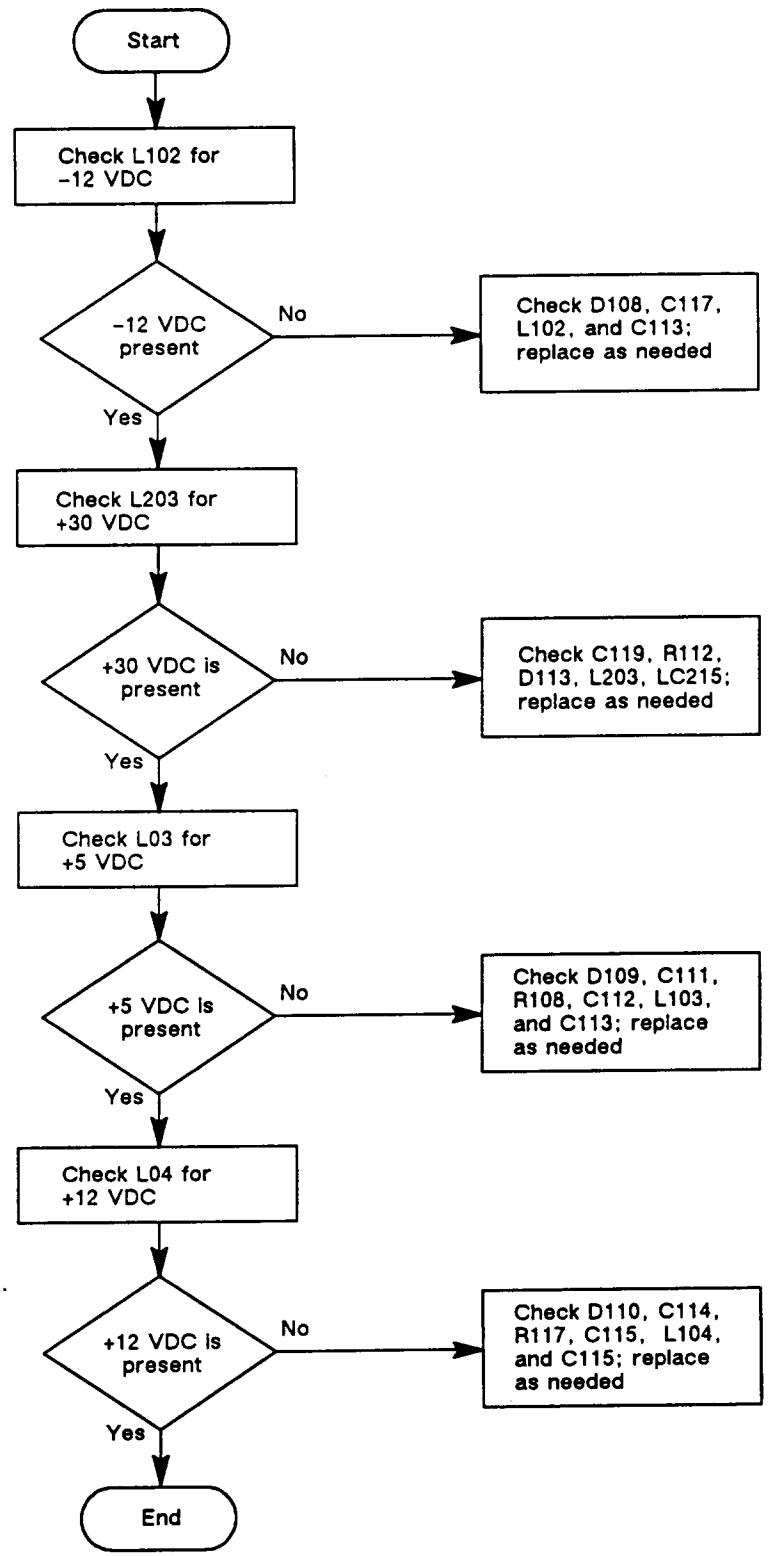

Start
Check A/C input voltage; then check the fuse
Warning
Voltages are lethal.
Input voltage and fuse are O.K.
No
Check A/C plug; if fuse is bad, replace it.
Yes
Check AC voltage at D104 and D103 (170 VAC)*
AC voltage is present
No
Check C102, C103, C104, L101, C101, and R101; replace as required
Yes
Check rectifier voltage at C105 (+170 VDC)*
Rectifier voltage is correct
No
Check D101, D102, D103, and D104; replace as needed
Yes
End
*310 V for 220 V model

Figure 2-8 Transformer Flowchart



* 310 V for 220 V model

Figure 2-9 Power Supply Flowchart



Power Supply Test Points

Voltage	Location
+5.0	C113
+12.0	R110
-12.0	C118
+30.0	R115
+15.0	C116
+55.0	R224

VR 101 will adjust +5.0 Volts and +30.5 Volts

Figure 2-10 Horizontal Controller IC 201 Flowchart

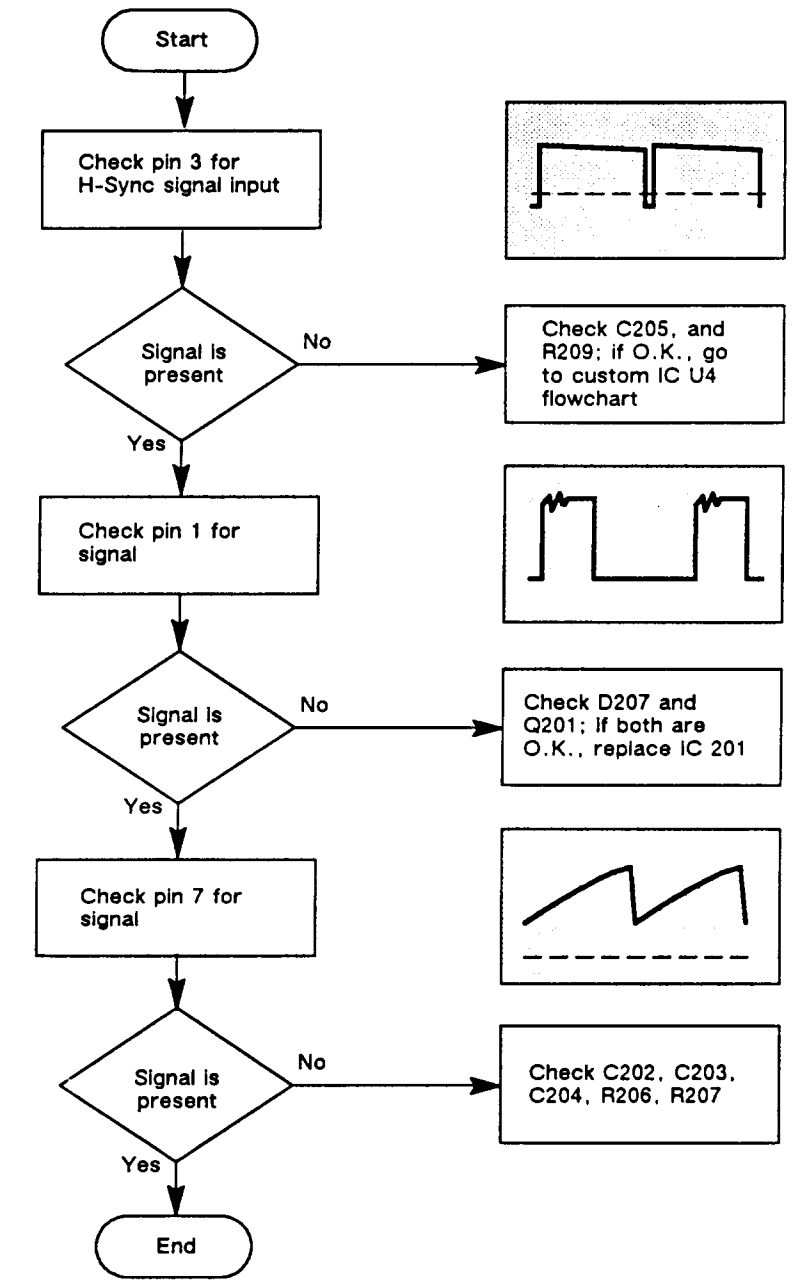


Figure 2-11 Vertical Controller IC 301 TDA 1170 Flowchart

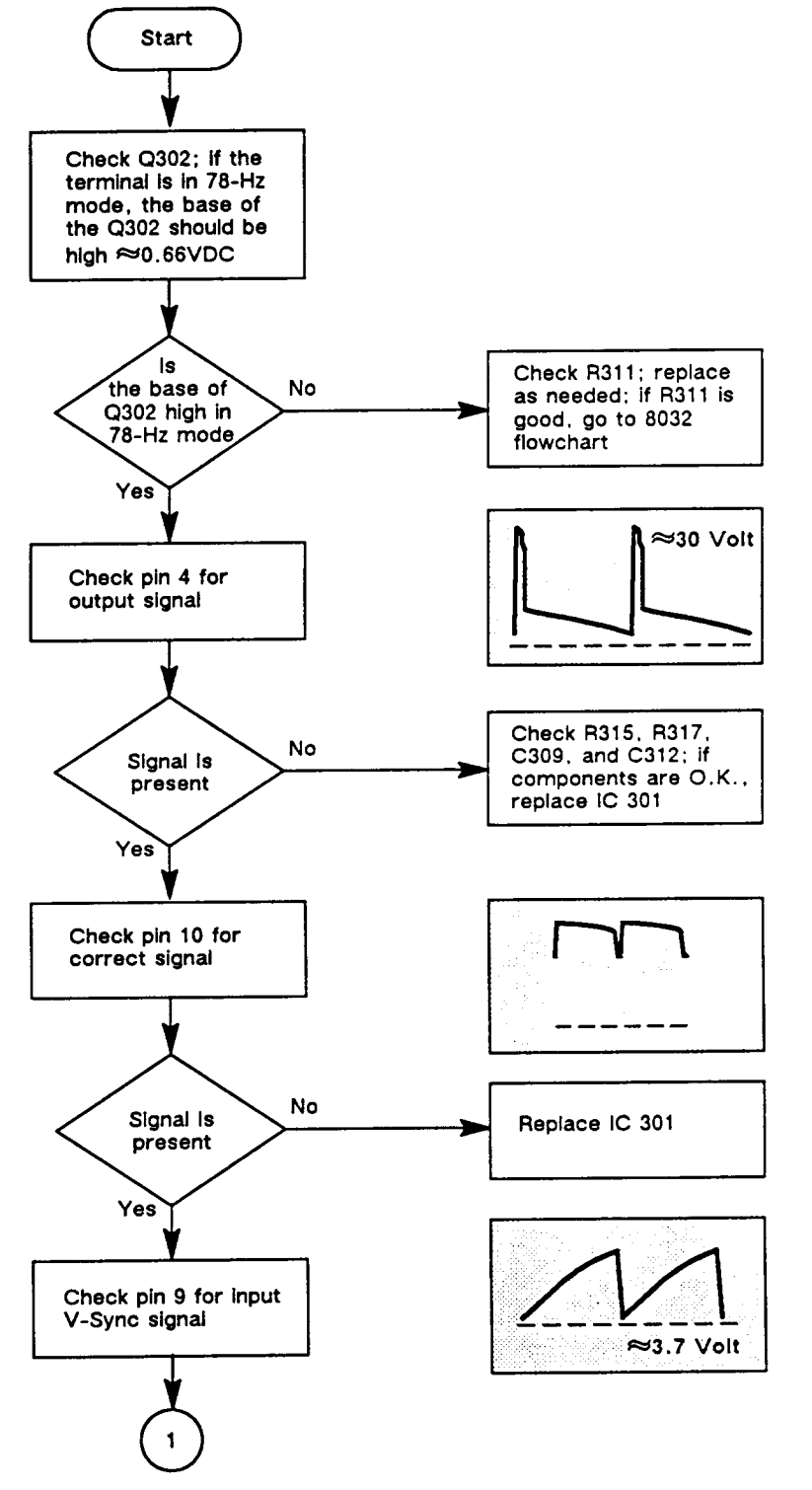

Start
Check Q302; if the terminal is in 78-Hz mode, the base of the Q302 should be high ≈0.66VDC
Is the base of Q302 high in 78-Hz mode
No
Check R311; replace as needed; if R311 is good, go to 8032 flowchart
Yes
Check pin 4 for output signal
≈30 Volt
Signal is present
No
Check R315, R317, C309, and C312; if components are O.K., replace IC 301
Yes
Check pin 10 for correct signal
Signal is present
No
Replace IC 301
Yes
Check pin 9 for input V-Sync signal
≈3.7 Volt
1

Figure 2-11 Vertical Controller IC 301 TDA 1170 Flowchart, Continued

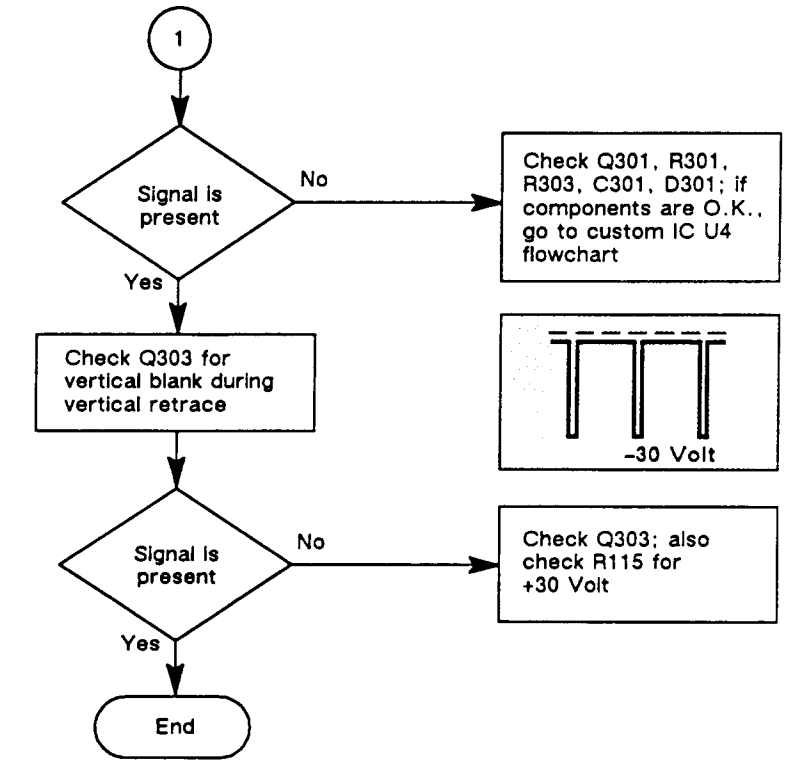
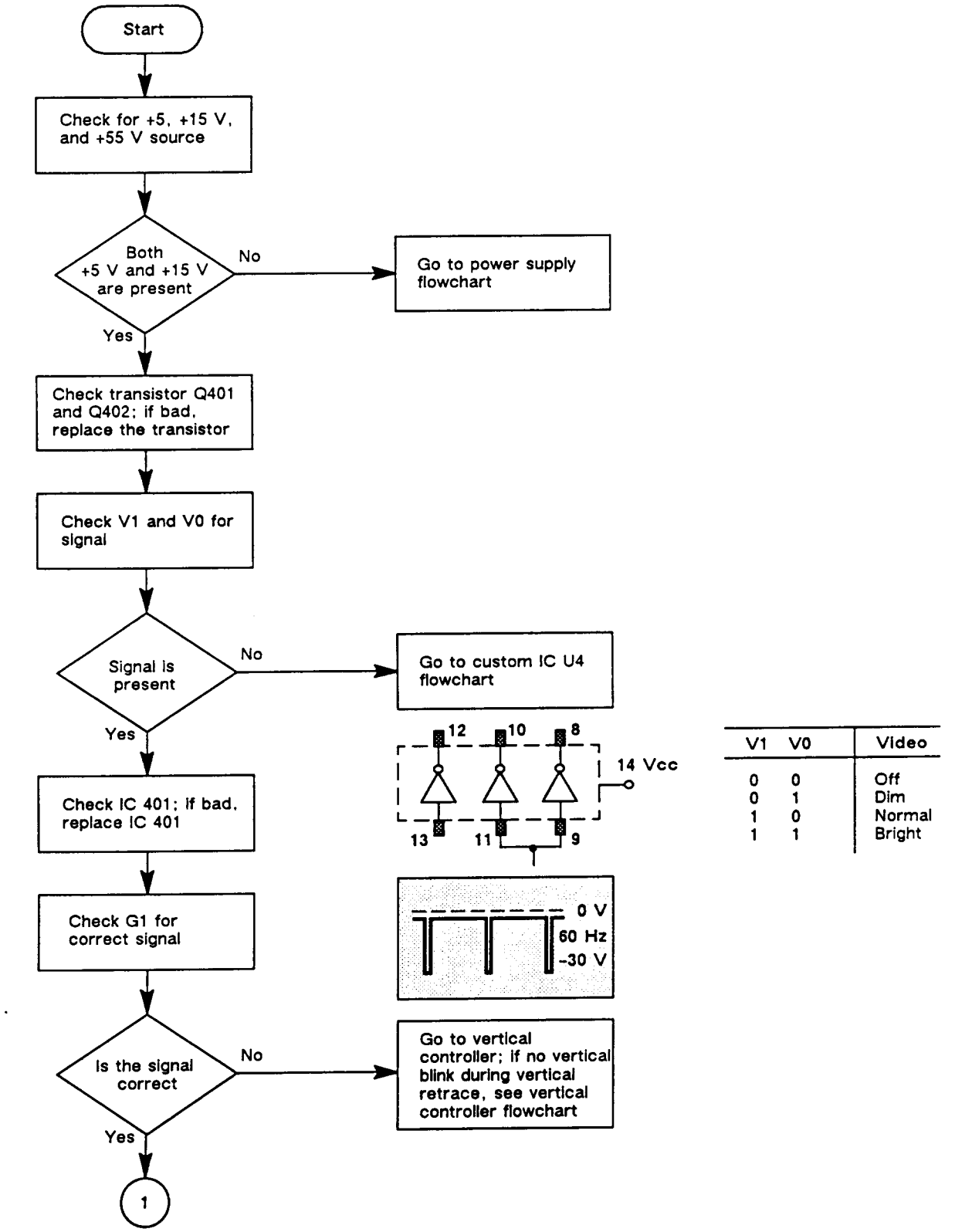


Figure 2-12 CRT Driver Flowchart



V1	V0	Video
0	0	Off
0	1	Dim
1	0	Normal
1	1	Bright

Figure 2-12 CRT Driver Flowchart, Continued

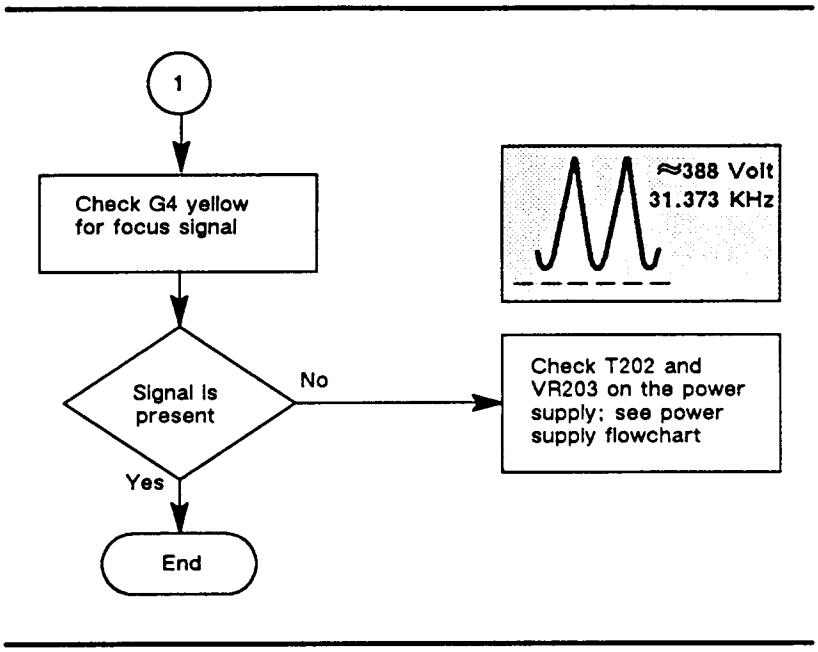
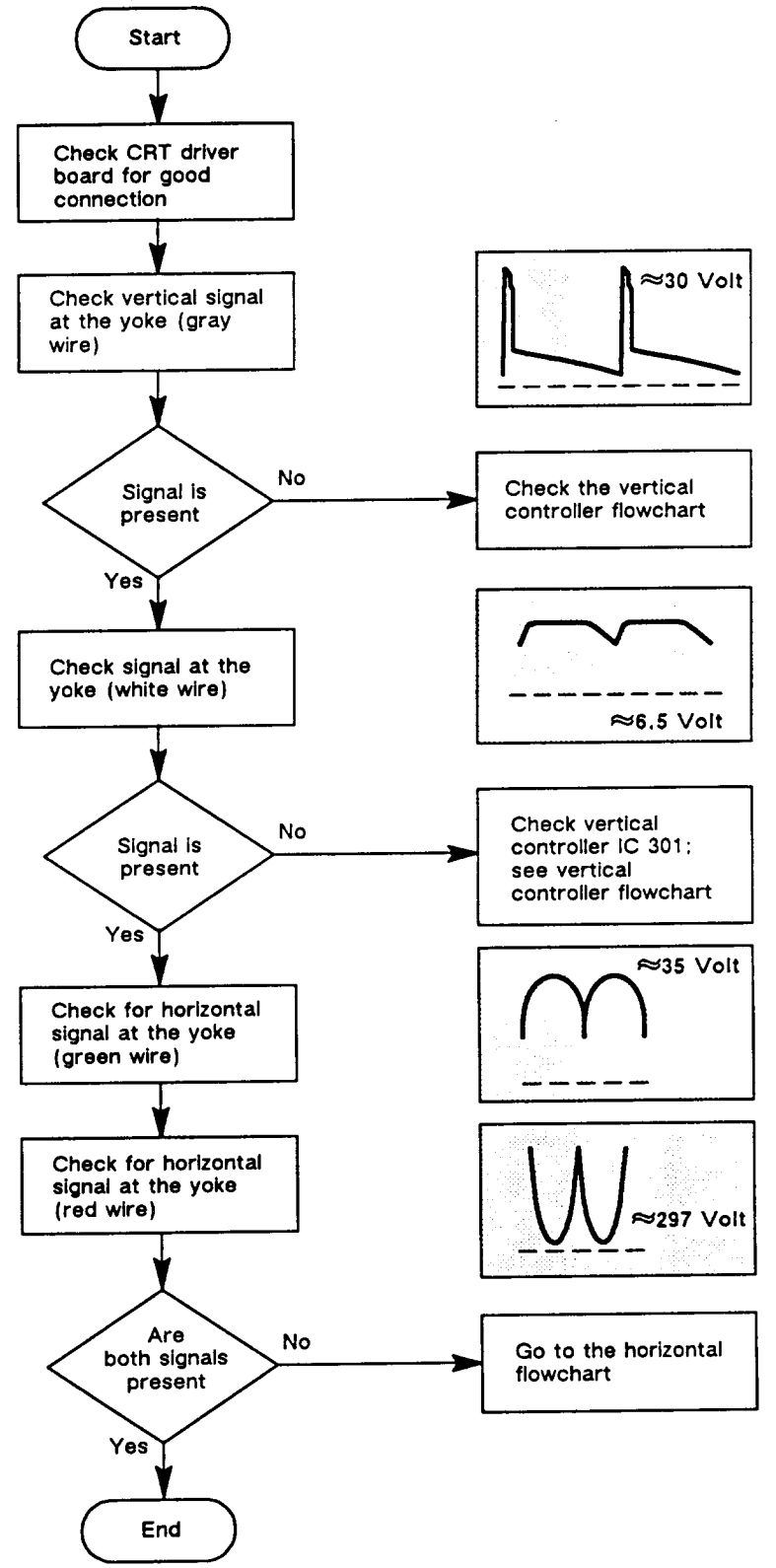


Figure 2-13 CRT Flowchart



3 Adjustments and Alignments

OVERVIEW

This section describes adjustments and alignments for the terminal in the higher-resolution 60-Hz mode (instructions are given for doublechecking in 78-Hz mode). In particular, this section discusses voltage adjustments, full terminal alignment, and individual adjustments. Before you align the terminal, check if the display meets the specification. If it doesn't, follow the set of instructions in the alignment section. You should complete a full terminal alignment whenever you replace the terminal printed circuit board (PCB) or the cathode ray tube (CRT)/yoke assembly.

Safety Summary

This terminal contains high voltage. Don't attempt to service the terminal without taking the following precautions:

- Turn the terminal off and disconnect the power cable.
- Remove jewelry from your hands and wrists.
- Avoid wearing clothing made of synthetic fabrics.
- Use insulated or nonconductive tools.
- Handle circuit boards only by their edges.
- Don't reconnect the power cable or turn the terminal on unnecessarily while the top cover is removed.
- Whenever you connect or disconnect the anode from the anode lead, make sure to discharge the anode as directed in Section 1.

⚠ **Warning** The CRT/yoke assembly has high voltages. Only qualified service personnel should adjust it.

- If you need to remove or replace the CRT/yoke assembly, remember that it can implode if you drop it or break the neck. The flying glass can injure anyone within a radius of ten feet.
- Always use the manufacturer's replacement components. Especially critical components as indicated on the circuit schematics should not be replaced with any component other than the manufacturer's. Where a short circuit has occurred, replace those components that indicate evidence of overheating.

Required Tools

We recommend that you have at least the following tools available before testing the power supply voltages or making any adjustments to the terminal display:

- Flat-blade nonconductive alignment tool
- No. 2 Phillips screwdriver

- Digital voltmeter (DVM)
- Millimeter ruler or reticle (See Appendix A for instructions on how to use the reticle when you check the display.)
- Loopback diagnostic test connectors (provided at the back of this maintenance manual)

SETTING UP THE TEST PATTERNS

1 Turn off the terminal. Unplug it from its AC power source, and disconnect any communications cables.

2 Attach loopback diagnostic test connector LB1 to the MAIN port and the EVEN loopback diagnostic test connector to the AUX1 port on the terminal's rear panel. Loopback connector pin numbers and signals for the ports are shown in Table 3-1.

Table 3-1 Loopback Test Connector Pin Assignments

Loopback Port	Pin	Signal
MAIN	2-3	TXD → RXD
	4-5	RTS → CTS
	8-20	DCD → DTR
AUX1 (Even Parallel)	2-10	D0 → ACK
	4-11	D2 → BUSY
	6-12	D4 → PE
	8-15	D6 → ERROR
	1-LED-17	STB → Ground
AUX1 (Odd Parallel)	3-10	D1 → ACK
	5-11	D3 → BUSY
	7-12	D5 → PE
	9-15	D7 → ERROR
	1-LED-17	STB → Ground

3 Plug in the terminal and turn it on. Let the terminal run for 30 minutes to ensure display stability and to prevent distortion.

The test screen alternates between a "walking" RAM character pattern and a "walking" attribute pattern.

☐ **Note** If the terminal emits a beep and displays an error code, turn to Section 2, "Troubleshooting," for an interpretation of the error codes and more instructions.

4 Press [Spacebar] to bring up the "m" test pattern.

5 Press [Ctrl] and [A] simultaneously to bring up the pincushion test pattern.

6 Simultaneously press [Ctrl] and [S] to toggle the refresh rate between 60 Hz and 78 Hz.

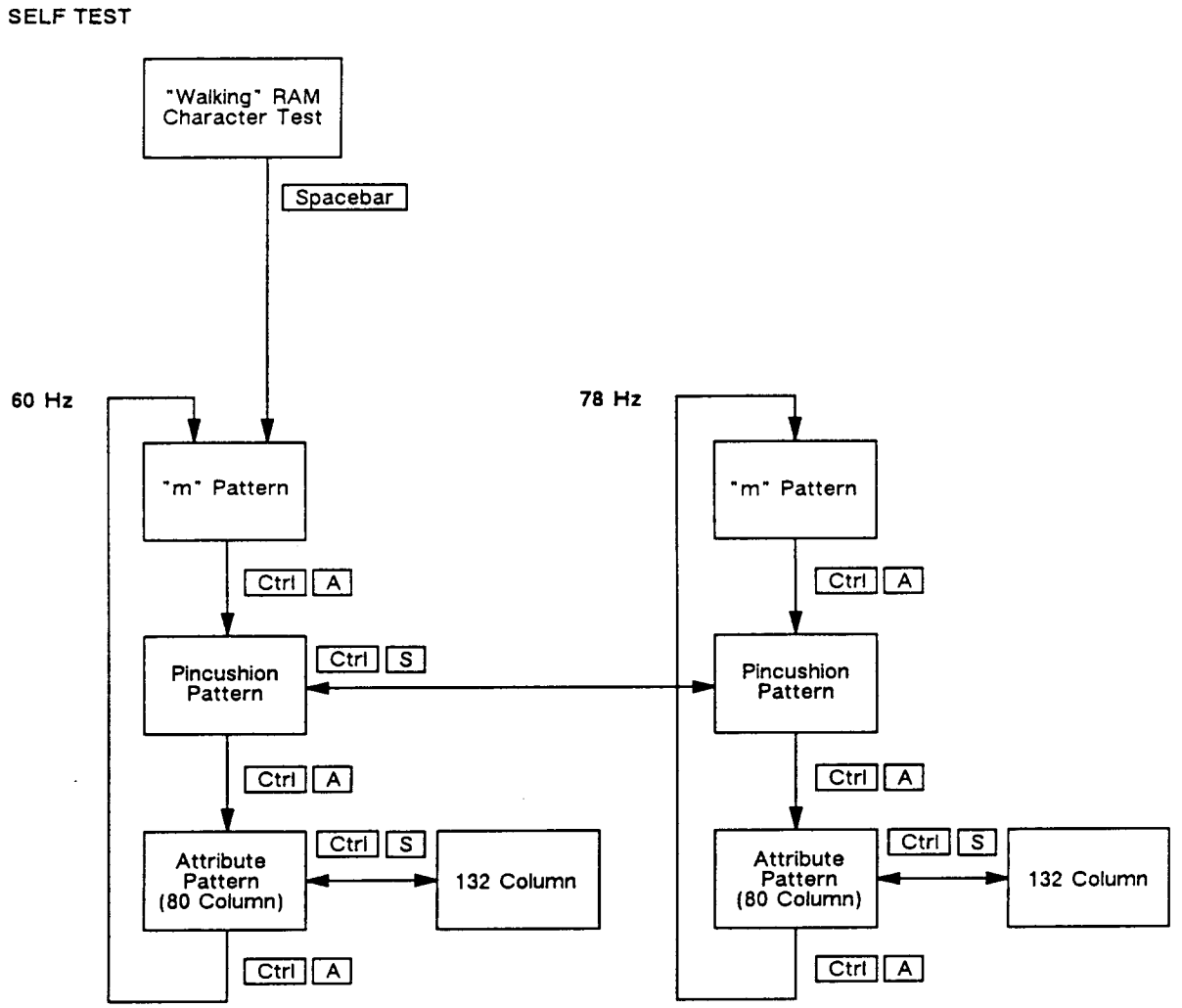
☐ **Note** The [Ctrl] [S] key sequence for 60/78-Hz mode switching works with the pincushion test screen only. Simultaneously pressing [Ctrl] and [A] displays the next test pattern.

7 Call the font size/character attribute test pattern by simultaneously pressing Ctrl and A.

8 Press Enter to return to the "walking" RAM character test screen.

Figure 3-1 shows the test pattern sequence for both 60-Hz and 78-Hz modes.

Figure 3-1 Test Pattern Sequence



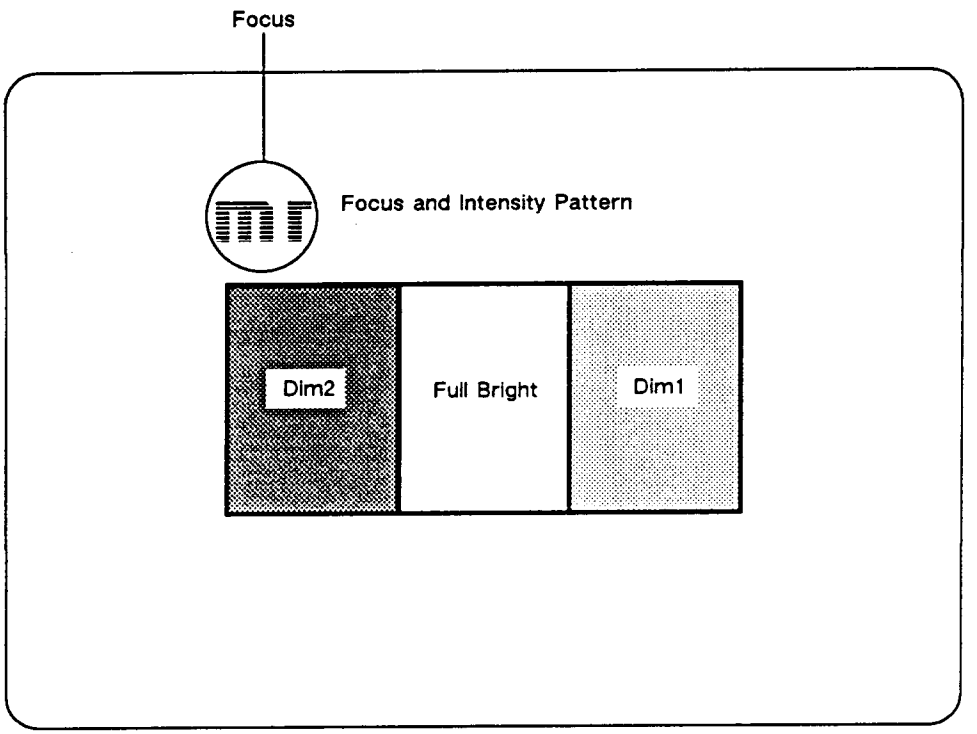
CHECKING THE DISPLAY SPECIFICATION

1 Bring up the pincushion test pattern (Figure 3-2). For instructions, see "Setting Up the Test Patterns."

2 Measure the margins on the top, bottom, and both sides of the pincushion test pattern. Each margin should measure 11 mm ±2 mm. If you have a reticle, see Appendix A for instructions.

Figure 3-2 The Pincushion Pattern Test Screen

Figure 3-3 The "m" Pattern Test Screen



4 Plug in the terminal and turn it on. Let the terminal run for 30 minutes to warm up.

5 Select the higher-resolution 60-Hz mode for testing, then toggle to the 78-Hz mode (simultaneously press Ctrl S) from the pincushion pattern to doublecheck the adjustments. For instructions, see "Setting Up the Test Patterns."

6 Bring up the pincushion test pattern (see "Setting Up the Test Patterns").

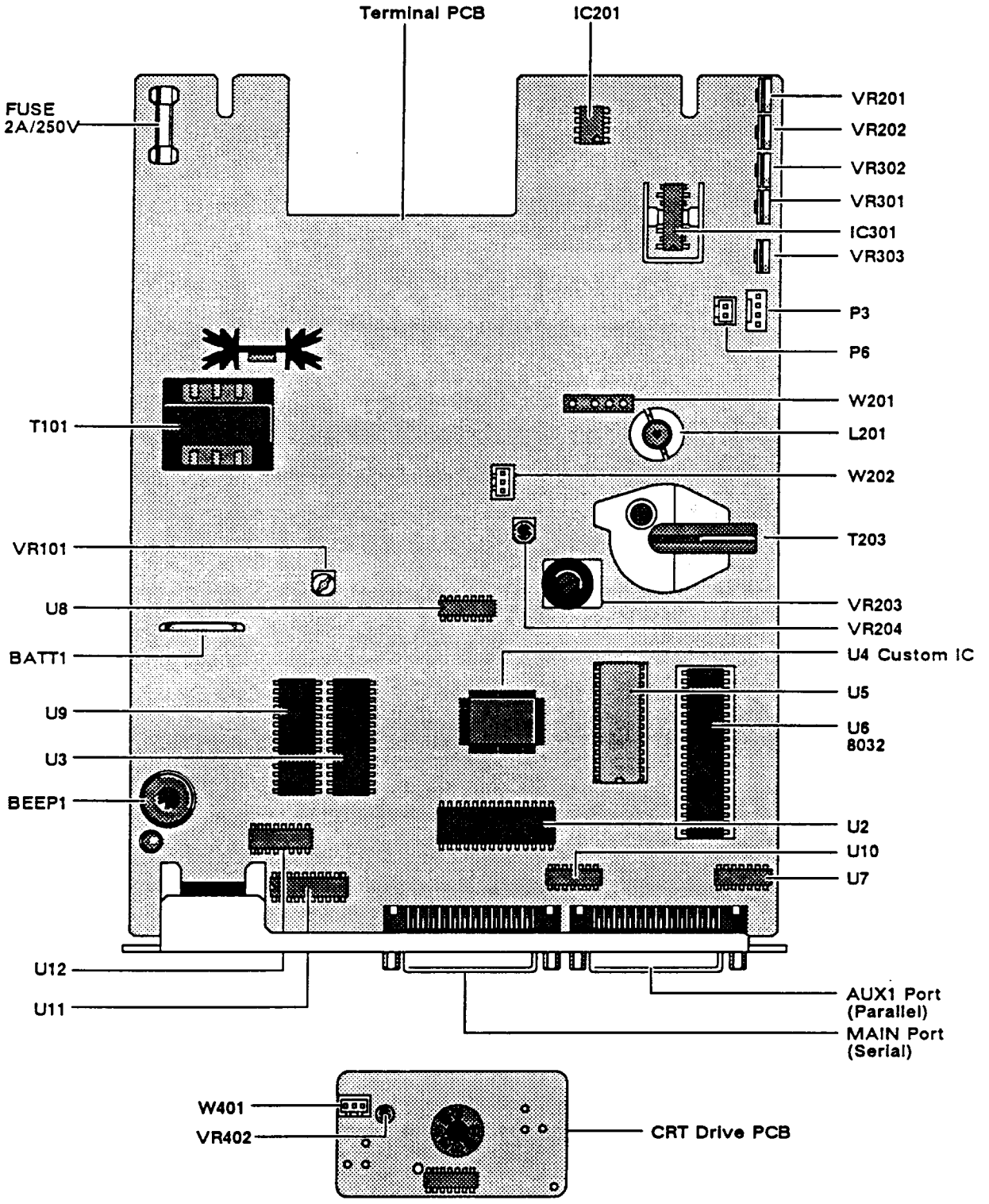
ADJUSTING THE VOLTAGE

☐ **Note** To save time and effort, it's important to adjust the voltage to the correct level before performing any other alignments.

Check the +30.5VDC ±2 percent at R115 and ±5VDC ±2 percent at R114 (Figure 3-4). If the voltage is not correct, adjust VR101. If the voltage will not adjust satisfactorily, see the power supply troubleshooting flowchart in Section 2.

Figure 3-4 shows the location of the terminal PCB components.

Figure 3-4 Component Locations on the Terminal PCB



ADJUSTING THE TERMINAL DISPLAY

Instructions are provided adjacent to each drawing in Table 3-2 for adjustments to the terminal display.

Table 3-2 Display Adjustment Quick Reference Guide

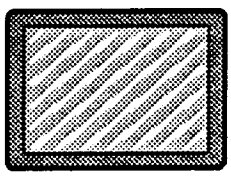
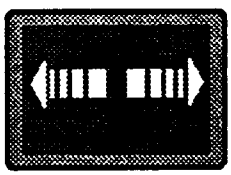
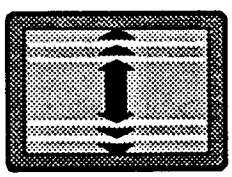
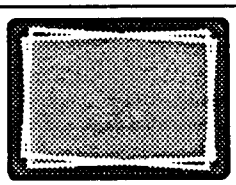
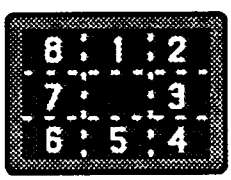
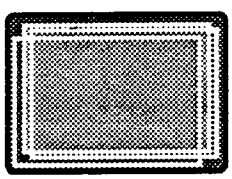
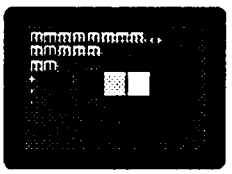
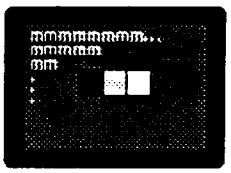
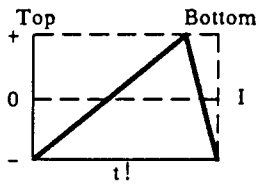
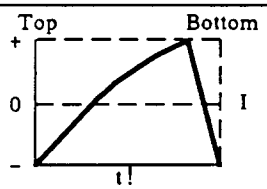
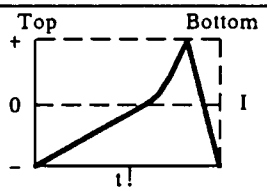
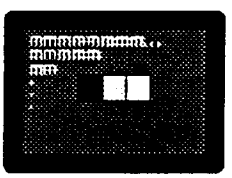
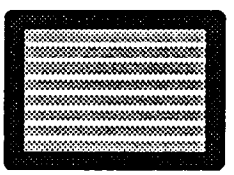
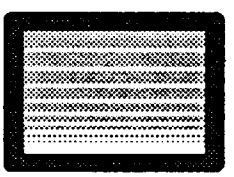
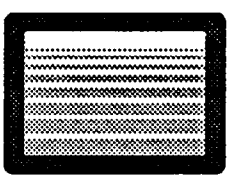
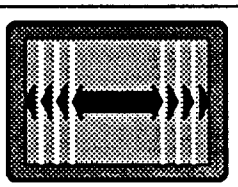
Adjustment	Component	Display
Voltage Adjustment	VR 101	+30.5 VDC ± 2% + 5.0 VDC ± 2%
Horizontal Hold	VR 201	
Horizontal Phase	VR 202	
Vertical Size 78 Hz Size	VR 302 Vertical margin should be 11 mm ± 2 mm VR 301	
Display Rotation	Rotate the yoke. NOTE: Do not tighten the yoke lock too tightly or the CRT may break.	
Quadrant Adjustment	Rotate the display magnets to adjust the corresponding display quadrant.	
Centering the Display	Rotate the centering rings. Margin should be 11 mm ± 2 mm on all sides.	

Table 3-2 Display Adjustment Quick Reference Guide, Continued

Adjustment	Component	Display
Sub-Brightness Sub-Contrast	VR 204 VR 402	
Focus	VR 203	
Vertical Linearity Check the following possible problem areas: 1. Power supply voltage +5, +12, -12, +15, +30, and +55 2. Custom IC U4 V-Sync 3. Vertical linearity adjustment VR 303 4. Vertical controller circuitry	VR 303 Vertical Yoke Currents    	   
Horizontal Size	L 201 Horizontal margin should be 11 mm ±2 mm.	

☐ **Note** Make adjustments in 60-Hz mode first, then toggle to 78-Hz mode (simultaneously press Ctrl S) from the pincushion pattern to doublecheck the adjustments.

Vertical Size

The vertical size adjustment potentiometers are labeled VR301 and VR302 on the terminal PCB (Figure 3-4). With the terminal in 60-Hz mode (10x16 character cell), simultaneously press Ctrl A to display the pincushion test pattern.

Adjust the vertical size by following these steps:

1 Turn potentiometer VR302 until the top edge and the bottom edge of the display are both 11 mm ±2 mm from the edge of the bezel.

2 Simultaneously press Ctrl S to toggle to 78-Hz mode (10x13 character cell) pincushion display.

3 Adjust VR301 to the same specification as VR302.

4 Simultaneously press Ctrl S to toggle back to 60-Hz mode.

Horizontal Hold

Adjust VR201 (Figure 3-4) for minimum horizontal tearing.

Linearity

The linearity adjustment is labeled VR303 on the terminal PCB (Figure 3-4). To adjust the linearity,

1 Display the "m" test pattern.

2 Adjust VR303 until characters on the bottom of the display are the same height as those on the top.

Horizontal Size

■ **Caution** Do not use a metal tool to adjust the width coil. The magnetic properties of a metal tool will affect the adjustment.

The horizontal size adjustment is labeled L201 on the terminal PCB (Figure 3-4). To adjust the horizontal size,

1 Display the pincushion test pattern.

2 Adjust L201 until either side of the display is 11 mm ±2 mm from the edge of the bezel.

Display Rotation

⚠ **Warning** The CRT/yoke assembly has high voltages. Only qualified service personnel should service it.

The yoke lock, located on the neck of the CRT (Figure 3-5), corrects tilt problems (Figure 3-6). To correct tilt problems,

1 Display the pincushion test pattern.

2 Loosen the yoke lock thumbscrew on the neck of the CRT.

3 Rotate the yoke until the top and bottom edges of the display are level with the top and bottom of the bezel.

⚠ **Warning** Do not tighten the thumbscrew too much or the neck of the CRT will break, and shoot broken glass for a radius of ten feet.

4 Tighten the yoke lock thumbscrew.

Figure 3-5 Yoke Lock, Centering Rings, and Display Magnets

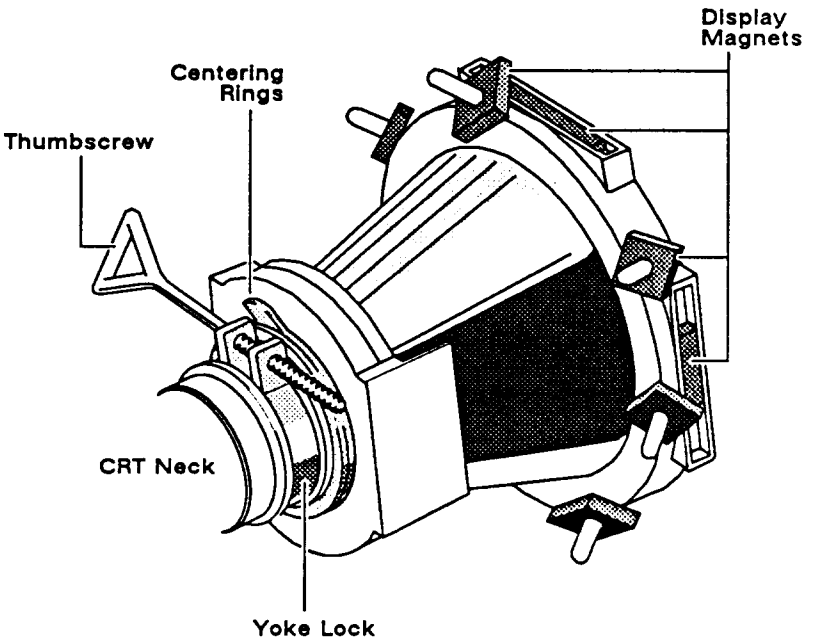
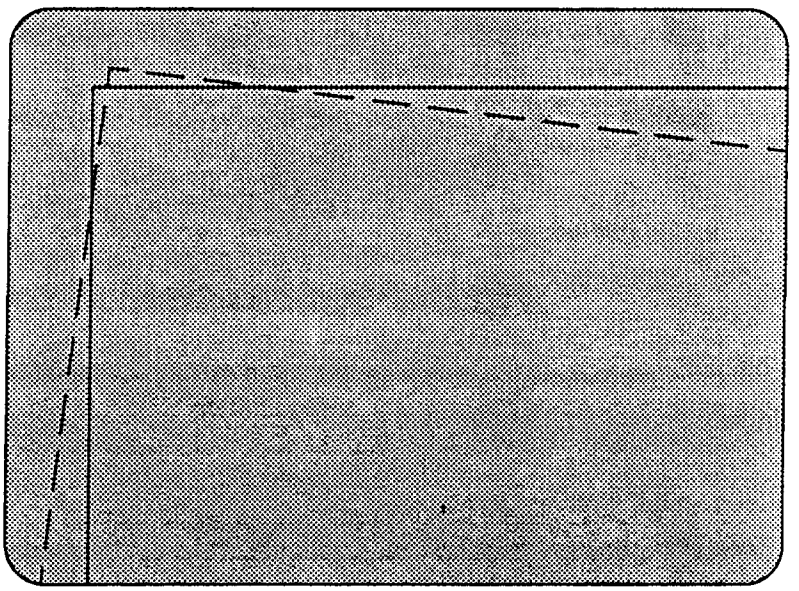


Figure 3-6 Display Tilt



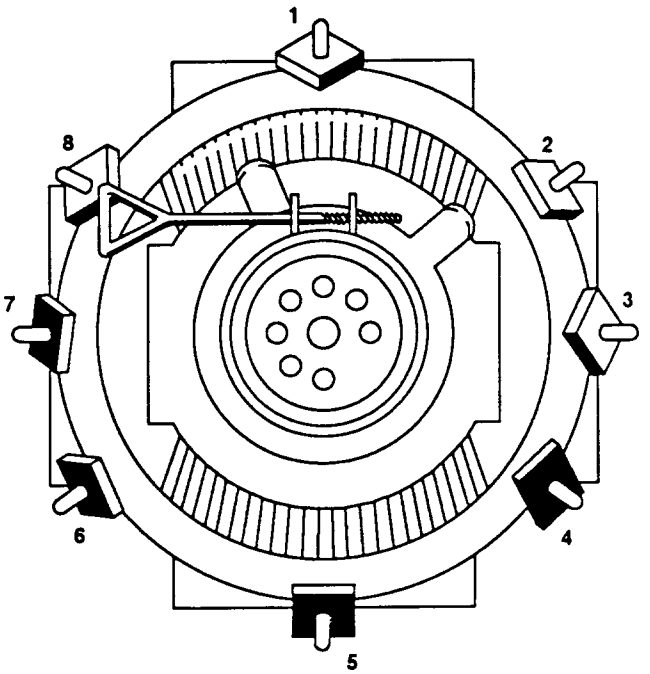
Centering Rings

There are two display centering rings around the yoke (Figure 3-5). When turned, they move the display position on the screen. Gently turn the rings until the display is in the center of the screen.

Display Magnets

There are eight display magnets on a ring around the yoke (Figure 3-7). When turned, they change the corresponding screen area and can also affect adjacent areas (See "Quadrant Adjustment" in Table 3-2).

Figure 3-7 Display Magnets



Brightness/Subcontrast Adjustment

Since excessive brightness can shorten tube phosphor life, you may wish to measure the three brightness levels with a correctly calibrated photometer. Perform the following steps to adjust the three degrees of brightness on the "m" test pattern:

1 Turn the operator brightness control knob fully clockwise.

2 Turn the operator contrast control knob fully counterclockwise.

3 Turn SUB-BRI, VR204, until the raster is just visible (2fL).

4 Turn the operator contrast control knob fully clockwise. You'll now see the three brightness blocks (Figure 3-3).

5 Look at the outside brightness blocks. If Dim2 is too bright or Full Bright is too dark, adjust subcontrast VR402 (on the CRT drive PCB) until you correct the problem.

Focus

☐ **Note** Don't use the focus control to adjust the outer extremities of the screen. Some focus distortion happens in any CRT. The focus adjustment is labeled FOCUS VR203 on the terminal PCB (Figure 3-4). Display the "m" test pattern. Adjust VR203 until the characters halfway between the center of the display and the bezel are distinct and clear.

4 Theory of Operations

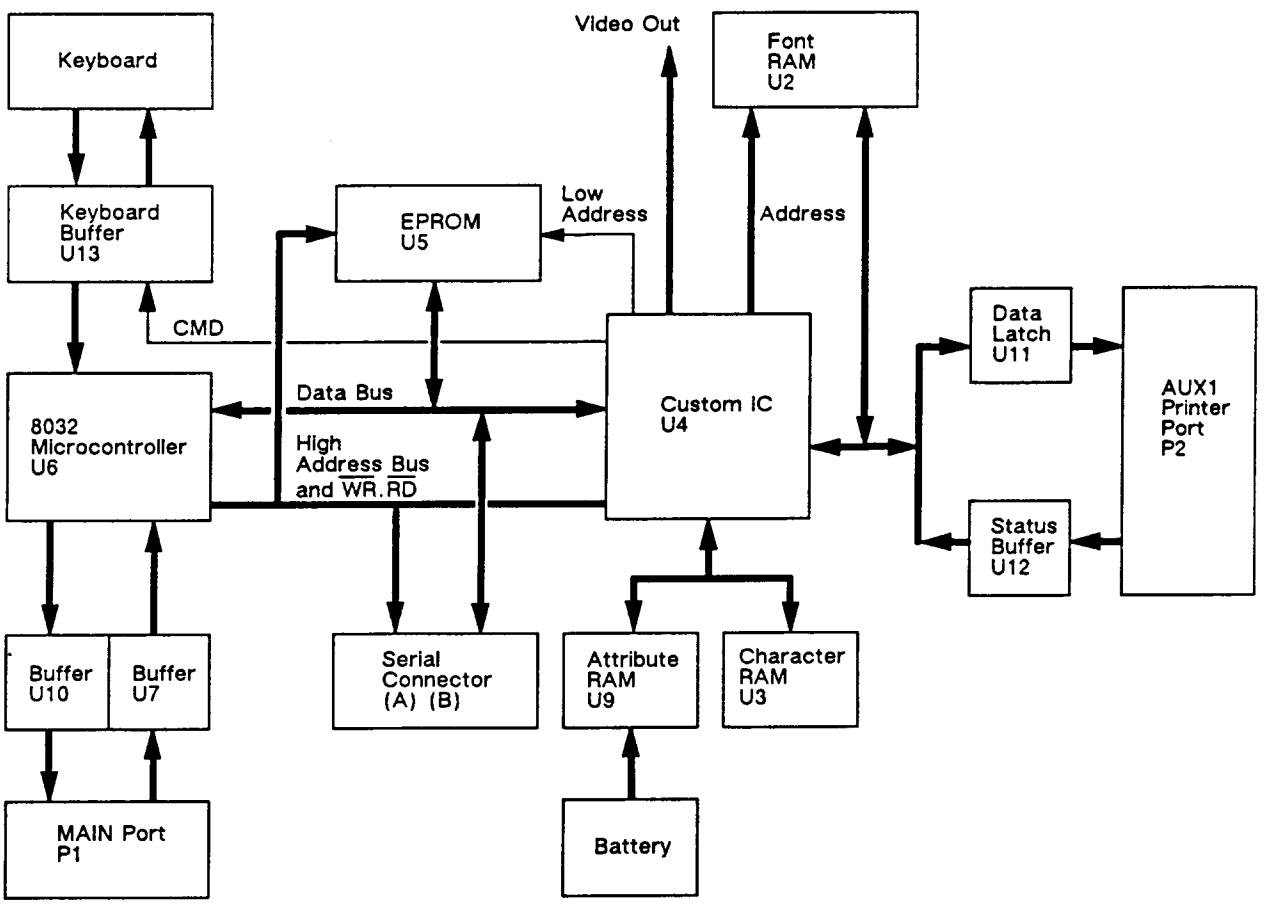
INTRODUCTION

This section provides a basic operational theory of the components of the terminal. A functional description of the monitor/power supply components follows the logic components description.

TERMINAL PCB LOGIC COMPONENTS FUNCTIONAL DESCRIPTION

The logic portion of the terminal consists of thirteen integrated circuits constructed around the 8032 microcontroller and the surface-mounted custom IC. A description and a reference designator for each significant component of the logic circuitry on the terminal PCB is shown in Figure 4-1.

Figure 4-1 Logic Circuitry Block Diagram



8032 Microcontroller (U6)

The 8032 is a control-oriented single chip microprocessor with four major ports (Figure 4-2). Table 4-1 lists the pin assignments for the 8032 microcontroller.

Figure 4-2 8032 Microcontroller Diagram

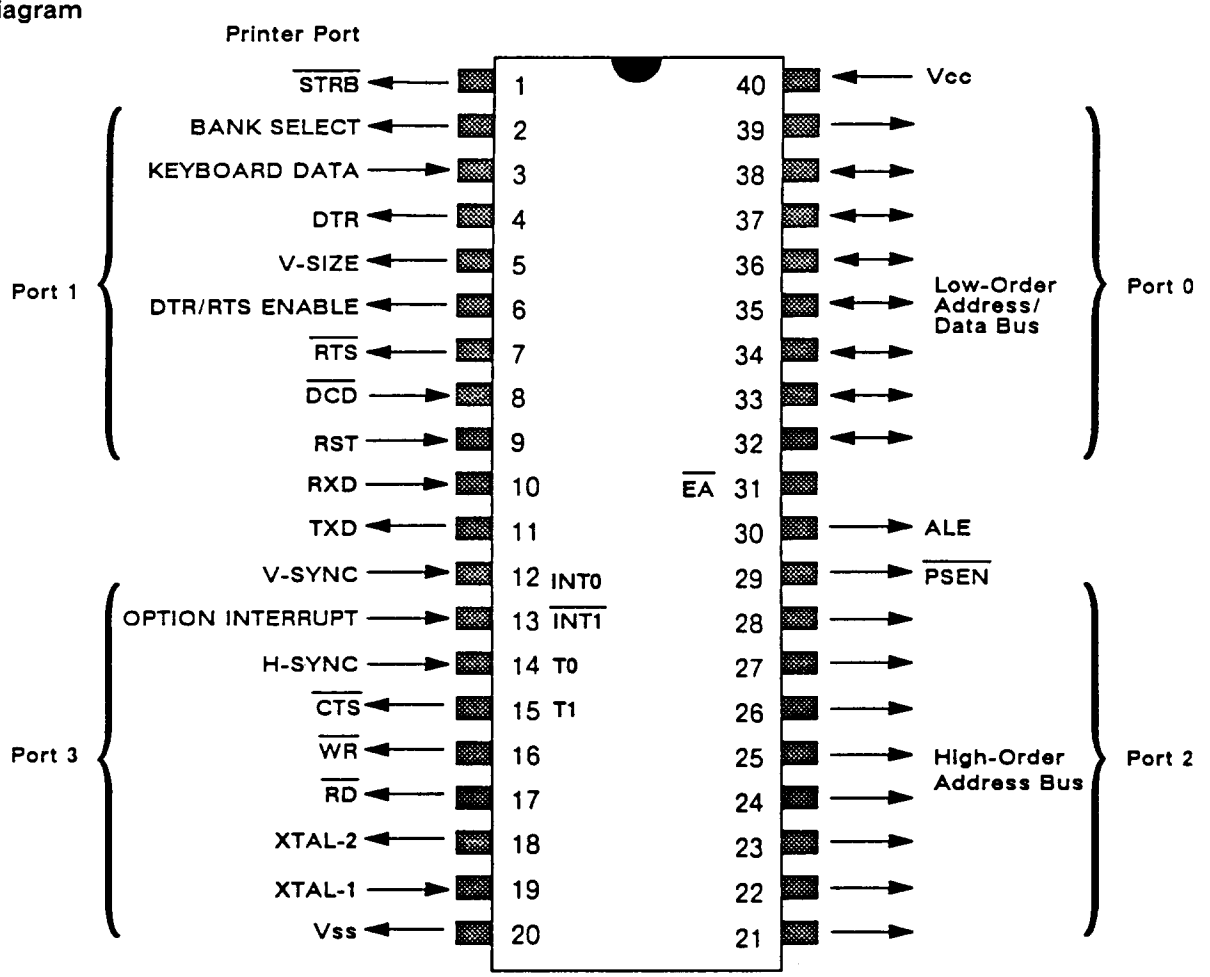


Table 4-1 Pin Assignments for the 8032 Microcontroller (U6)

Pin	Description
1	Printer port strobe
2	Bank select for the 27010 EPROM
3	Data input from the keyboard
4	DTR
5	Vertical size (should be high only in 78-Hz mode)
6	RS232/RS422 select
7	Request to send (RTS) output signal
8	Receive line signal detector (DCD) input signal
9	Reset
10	Data receive (RXD) input signal
11	Transmitted data (TXD) output signal
12	Vertical sync input signal

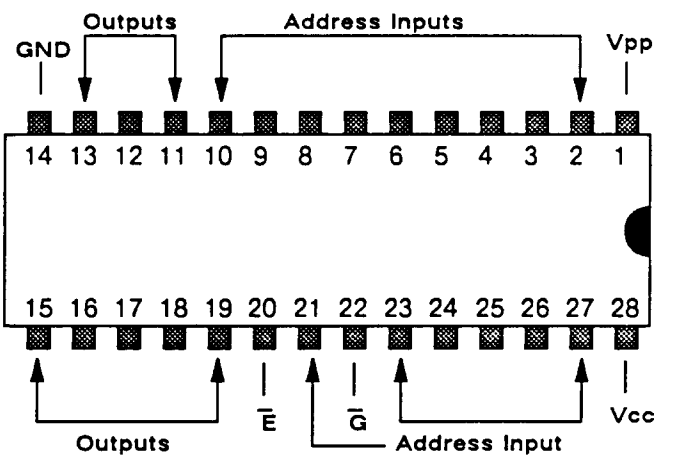
Table 4-1 Pin Assignments for the 8032 Microcontroller (U6), Continued

Pin	Description
13	Int 1
14	Horizontal sync input signal
15	Clear to send (CTS) input signal
16	Write (-WR)
17	Read (-RD)
18	X2
19	X1
20	Vss
21-28	Port 2, high order data bits
29	Program store enable (-PSEN) output signal
30	Address latch enable (ALE) output signal
31	NC
32-39	Port 0, low order data bits

System PROM (U5)

The programmable read-only memory (PROM) is a nonvolatile memory for program storage (Figure 4-3). The terminal PROM can be 16K, 32K, 64K, or 128K. All of the terminal routines reside in this PROM, which is accessed with the -PSEN strobe from the 8032 via the PROM's address input, followed by the output instructions or a routine.

Figure 4-3 PROM (U5) Diagram



A0–A14	Address Inputs
$\overline{E}$	Chip Enable
$\overline{G}$	Output Enable
GND	Ground
Q1–Q8	Outputs
Vcc	5 V Power Supply
Vpp	12.5 V Power Supply (for programming only)

Custom IC (U4)

This custom IC is surface-mounted in a 100-pin package. Vcc and ground each use four pins; the remaining pins are signal lines.

Major functions of the custom IC are as follows:

- Generates frame timing, both horizontal and vertical
- Contains a three-tone beeper driver
- Provides nonhidden and hidden attribute control circuits
- Provides video shift register and half-clock dot stretch
- Generates a font-selection signal
- Generates control signals for the display RAM
- Provides smooth scroll control
- Generates character and cursor blink rate
- Arbitrates memory control between the display and the microcontroller without disturbing the display
- Latches the address from the microcontroller for the EPROM

Pin assignments for custom IC U4 are given in Table 4-2.

Table 4-2 Pin Assignments for Custom IC U4

Description	Pin	Direction
+5 V	16	
+5 V	44	
+5 V	68	
+5 V	88	
Ground	17	
Ground	46	
Ground	66	
Ground	90	
RD	55	In
WR	57	In
ALE	28	In
Beeper	65	Out
Keyboard command	51	Out
Attribute write	1	Out
Character write	98	Out
Font write	3	Out
Parallel port enable (PPE)	5	Out
Dot clock	63	In
H-Sync	53	Out
V-Sync	59	Out
Font address 0-12	4, 6-15, 18, 20	Out
Font data 0-7	19, 21-27	In/Out
Character data 0-7	73, 75, 76, 78, 80-83	In/Out
Attribute data 0-7	67, 69-72, 74, 77, 79	In/Out
Address 0-7	34, 36, 38, 40-43, 45	Out
Address 8-15	29-33, 35, 37, 39	In

Table 4-2 Pin Assignments for Custom IC U4, Continued

Description	Pin	Direction
AD 0-7	47-50, 52, 54 54, 56, 58	In/Out
DADD 0-14	2, 84-87, 89, 91-97, 99, 100	Out
Video 0	64	Out
Video 1	61	Out

The custom IC generates the frame image and converts the data bytes of the character, attribute, and font RAM into a four-level pixel stream that goes to the CRT.

In normal operation the processor initializes the custom IC by writing to each of the 12 screen attribute bytes (SABS) and the row attribute byte (RAB). These bytes control all the video display timing.

Display RAM (U3, U9)

The display RAM consists of two 8Kx8 static RAMs. U3 stores the display character data. U9 stores the corresponding attribute byte for the character data in the hidden attribute mode. Both store characters and relative attributes in nonhidden attribute mode. The attribute RAM is backed up by a battery circuit that maintains the contents of the RAM when power is lost. Maximum access time for the RAM is 110 ns. The terminal's configuration (soft setup) is stored in the attribute RAM.

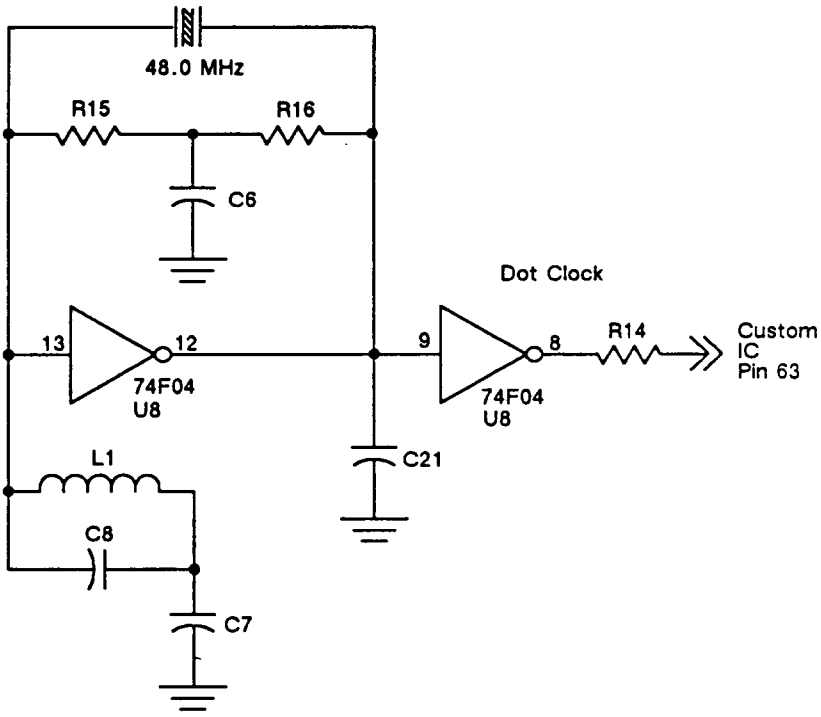
Character Fonts (U2)

Four 128-character fonts are stored in the 8Kx8 static RAM. Fonts are loaded into the RAM from the system PROM during power-up and can be downloaded by an application program.

System Clock (U8)

The system clock is derived from a 48-MHz Clapp oscillator built around U8 and Y1 (Figure 4-4). Of the 360 degrees of phase shift needed for oscillation, the inverter supplies 180 degrees, while capacitors C8 and C21 supply 90 degrees each. L1 and C8 form a resonant circuit to force the crystal to resonate at its third overtone. R15 and R16 form the feedback path from input to output. Capacitor C6 filters any AC signal from the bias network, R15 and R16. Capacitor C7 removes DC bias from the circuits. The output buffer is designed to provide a 48 percent to 52 percent square wave over the terminal's operating voltage and temperature range. The resulting dot clock shifts the serial video data from the custom IC U4 to the video amplifier. Dot clock is used for all internal timing.

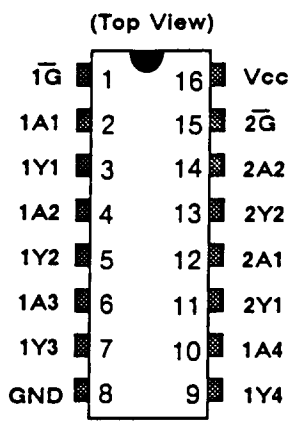
Figure 4-4 System Clock Diagram



Keyboard Buffer (U13)

The keyboard signals are buffered through U13, a 74LS368A hex inverting buffer (Figure 4-5).

Figure 4-5 Keyboard Buffer (U13) Diagram



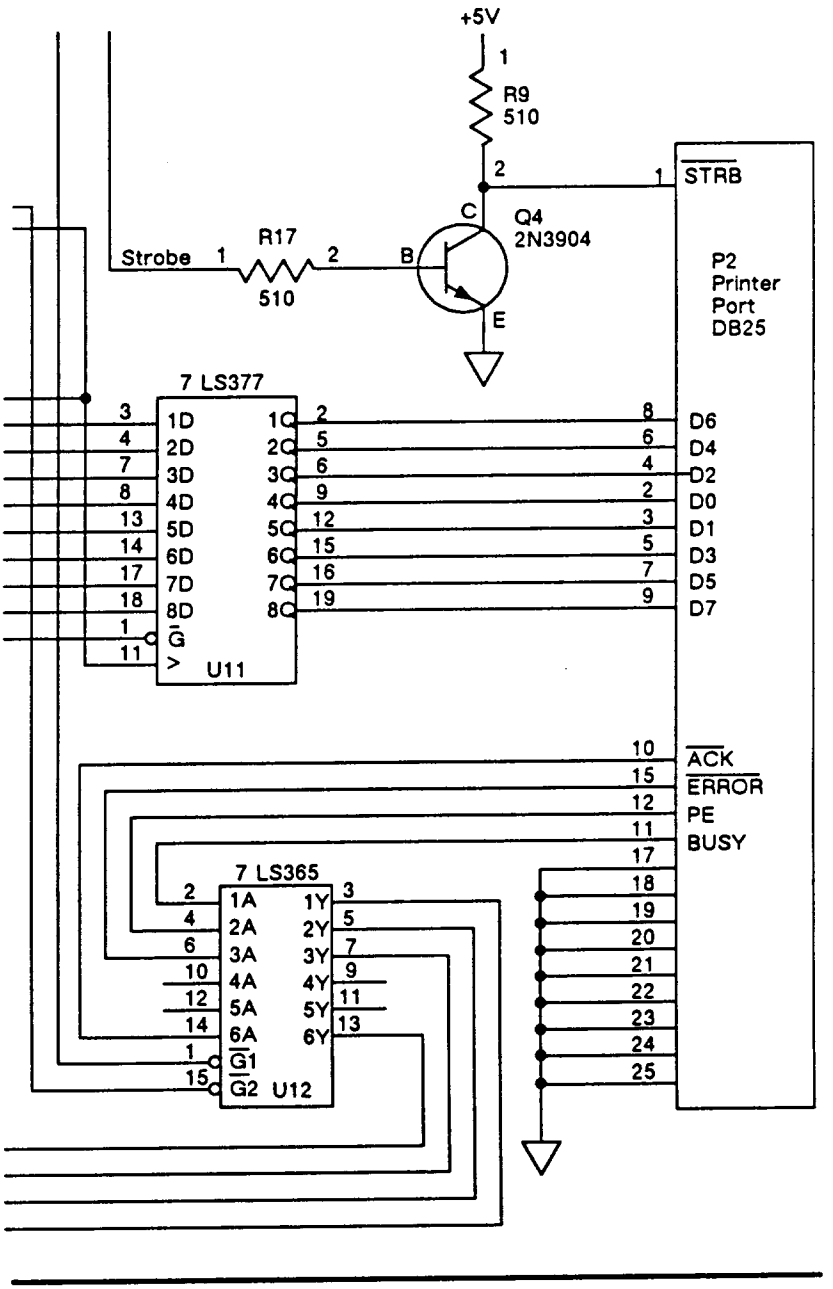
Battery Backup

The battery backup circuit consists of a battery, a LM393 dual comparator, and associated hardware. The comparator monitors the supply voltage, generates reset, deselects the RAMs, and activates the battery circuit.

Parallel Port (AUX1) (U11 and U12)

The parallel port consists of a 74LS365 hex tri-state buffer and a 74LS377 octal latch (Figure 4-6). Outgoing data is held in the latch and incoming status is read through the buffer. The data to and from the parallel port is multiplexed with the font data.

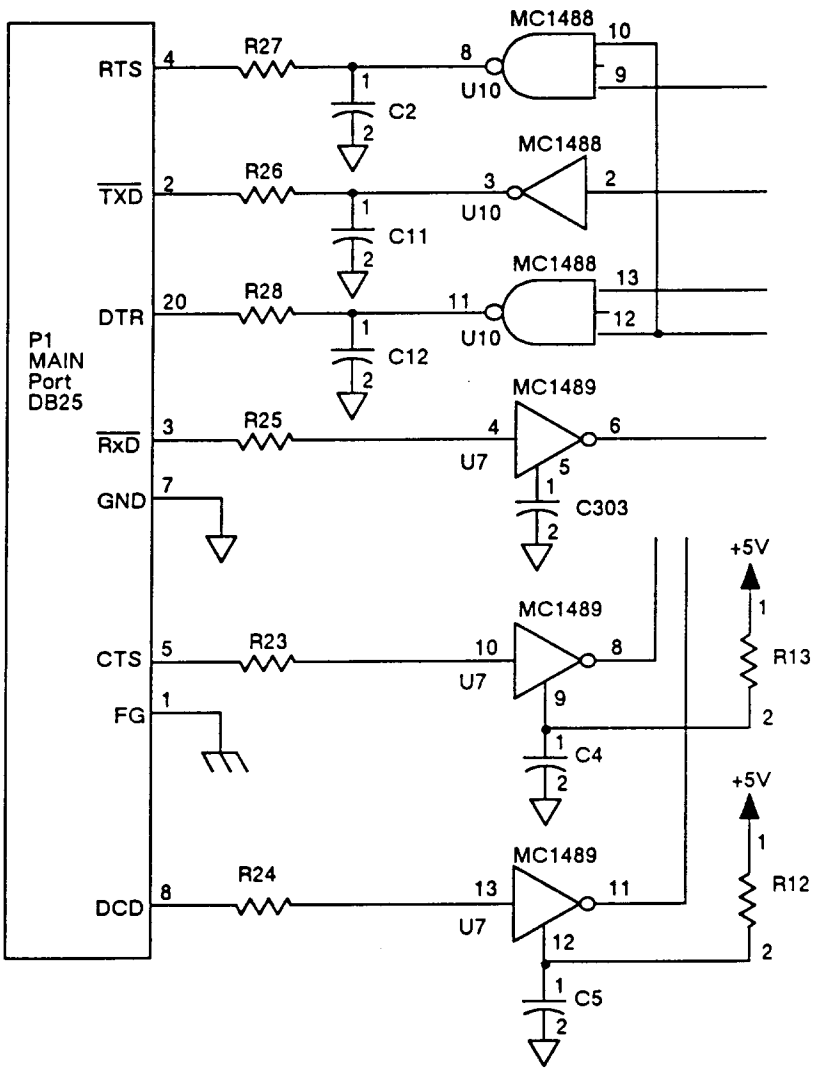
Figure 4-6 Parallel Port (AUX1) Diagram



Serial Port (MAIN)

The 8032 microcontroller's internal UART is buffered through a MC1488 RS-232 line driver and MC1489A RS-232 line receiver (Figure 4-7).

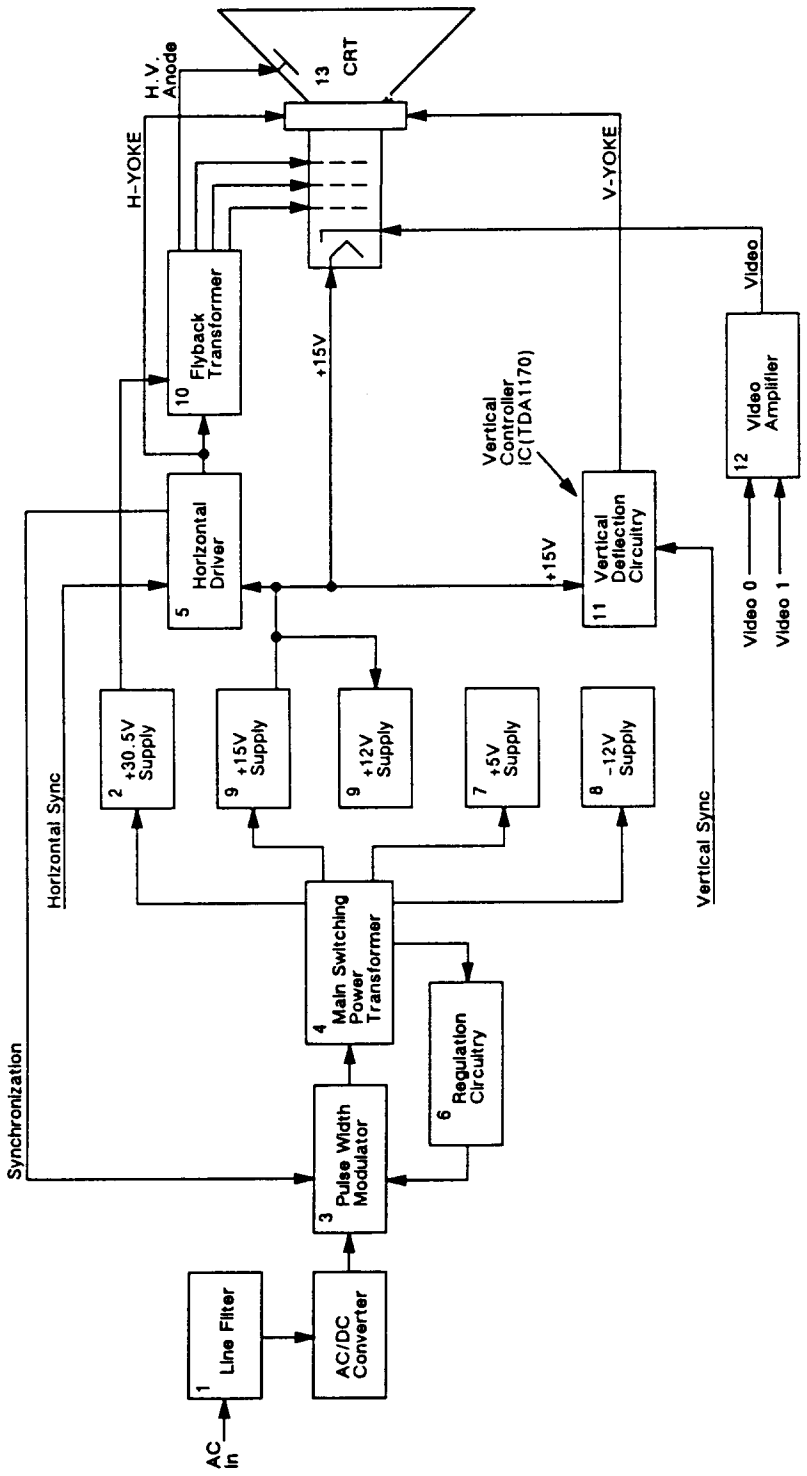
Figure 4-7 Serial Port (MAIN) Diagram



MONITOR/POWER SUPPLY COMPONENTS FUNCTIONAL DESCRIPTION

The terminal PCB contains both monitor and power supply circuitry. The monitor circuitry controls the video image on the CRT screen. The power supply circuitry provides the voltages for all the logic. Figure 4-8 is a functional block diagram of the monitor and power supply circuitry. Note that each block is numbered. This number corresponds with the item number in the following descriptions.

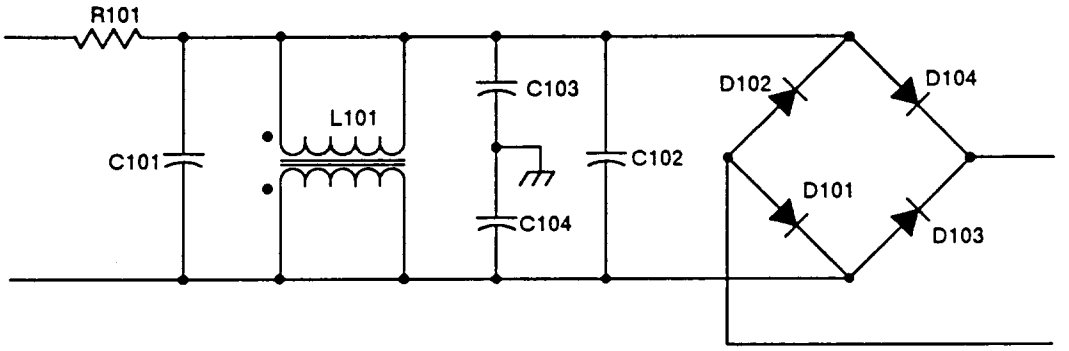
Figure 4-8 Monitor/Power Supply Block Diagram



Line Filter (1)

The line filter (Figure 4-9) attenuates noise from the external power source (the AC power cord and wall socket). To comply with FCC regulations, the line filter also filters any noise produced by the switching power supply.

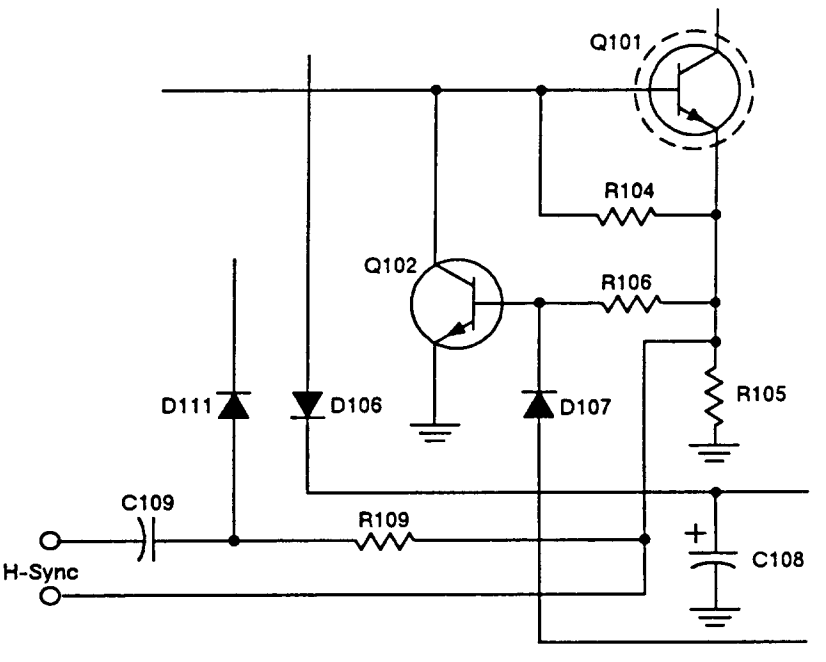
Figure 4-9 Line Filter



Pulse-Width Modulator (3)

The pulse-width modulator (PWM) consists of a pair of switching transistors (Figure 4-10). It sends AC input voltage to the main power transformer. The PWM is synchronized with the horizontal synchronization pulses to eliminate beat frequencies.

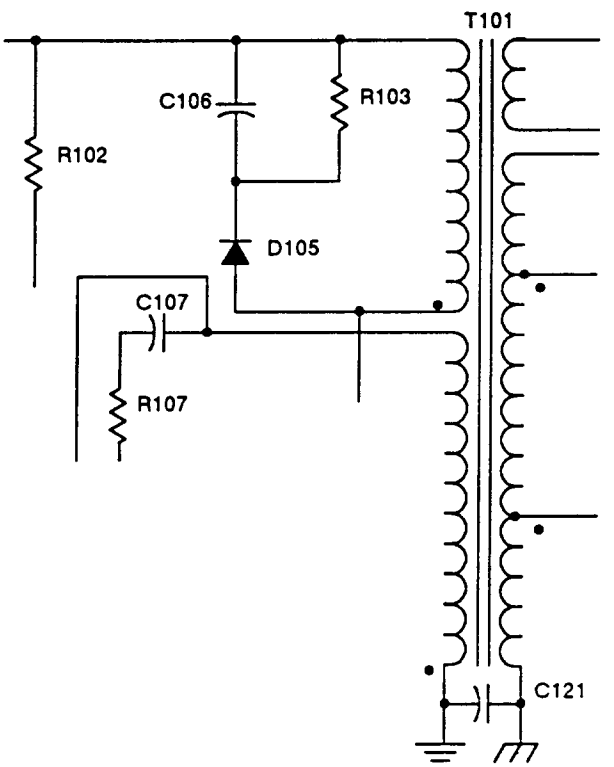
Figure 4-10 Pulse-Width Modulator



Main Switching Power Transformer (4)

The main power transformer provides taps for each power circuitry (Figure 4-11).

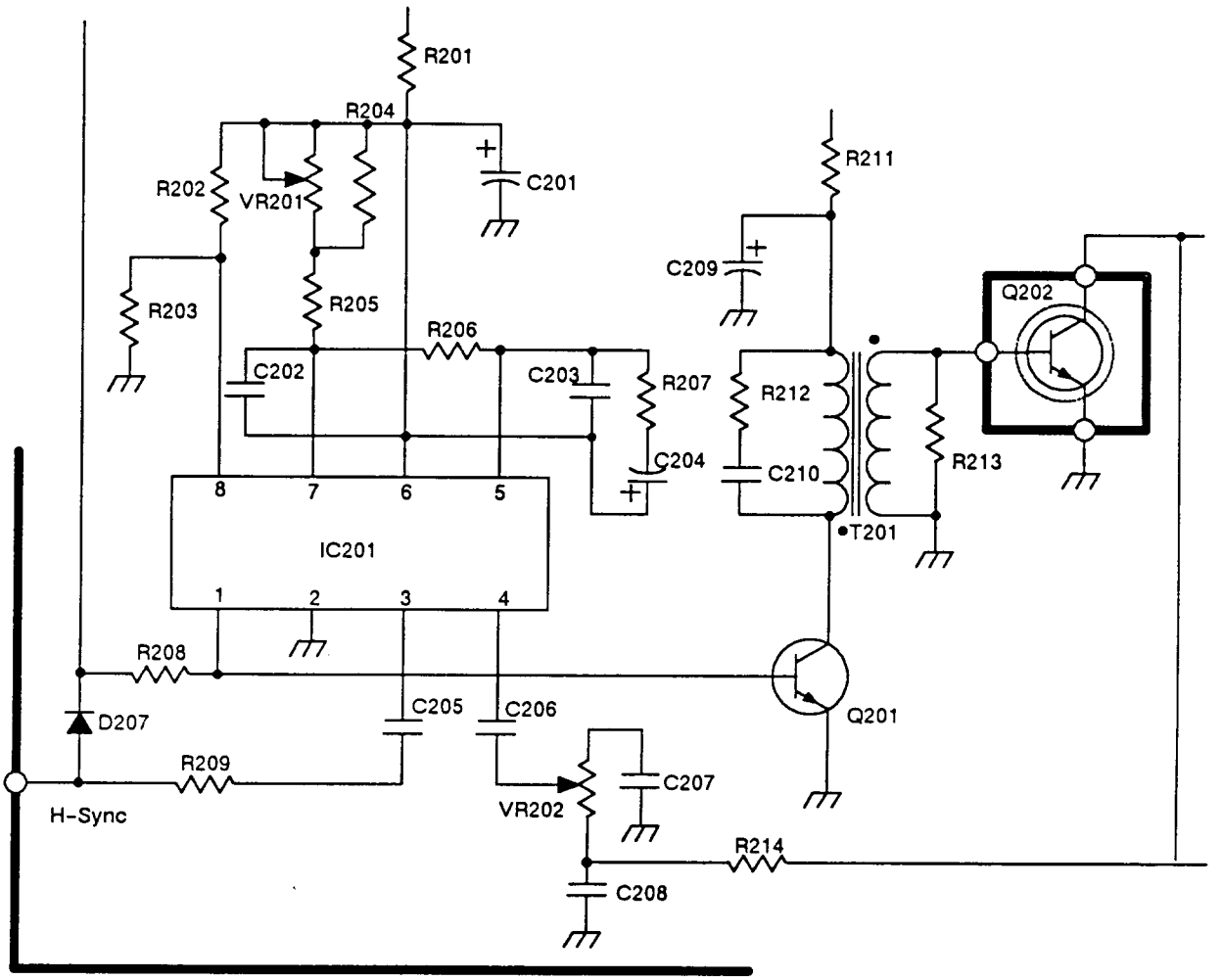
Figure 4-11 Main Switching Power Transformer



Horizontal Driver (5)

The horizontal driver drives the yoke at a given frequency so the electron beam sweeps from left to right at the correct rate. It also provides the signal to drive the flyback transformer (Figure 4-12).

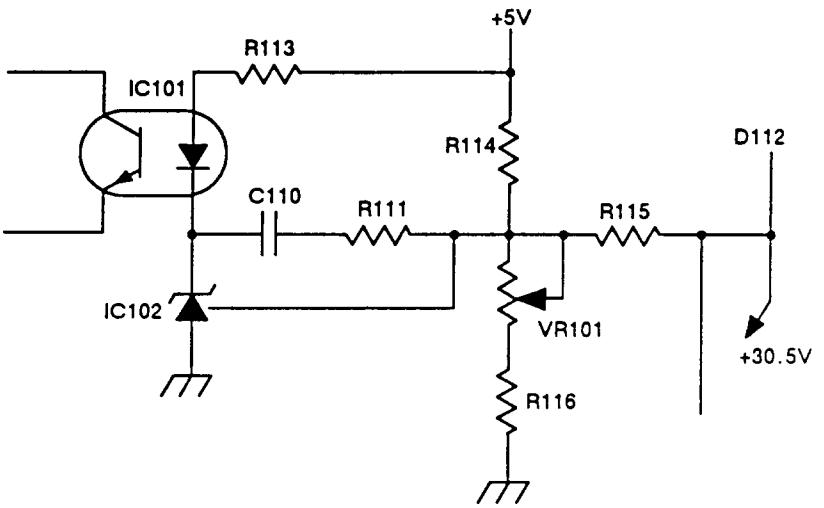
Figure 4-12 Horizontal Driver



Regulation Circuitry (6)

The regulation circuitry measures the +5 V and +30.5 V supplies (Figure 4-13). It generates an error voltage proportional to any error it may find when measuring the supplies. Optically coupling the error signal with the pulse-width modulator that controls its duty cycle regulates the output voltage of the main switching power transformer.

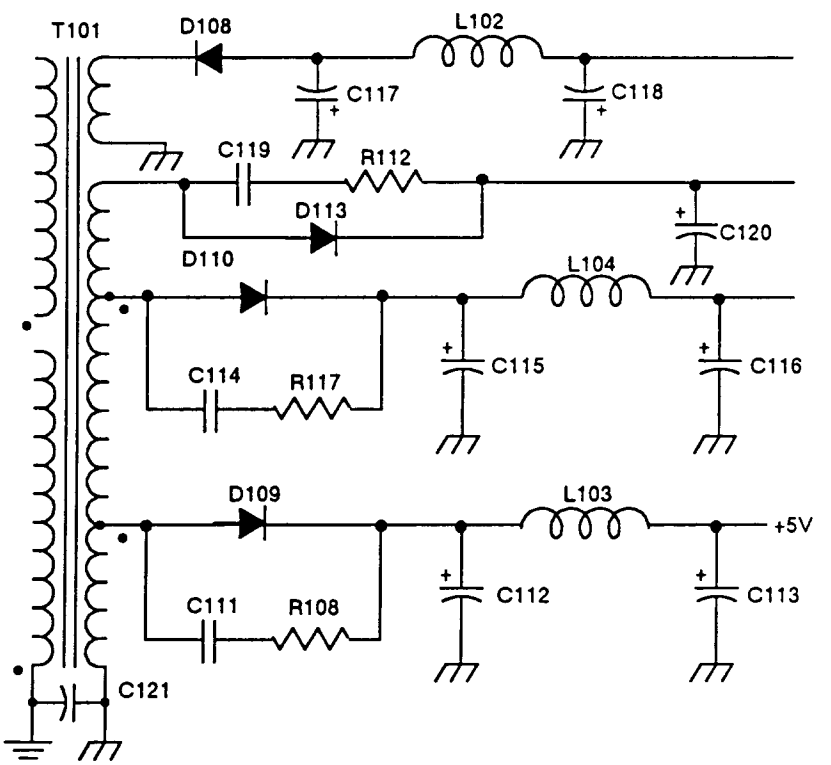
Figure 4-13 Regulation Circuitry



Output Filtering

Figure 4-14 provides the +5 V, −12 V, and +15 V power supply output filtering schematic.

Figure 4-14 Output Filtering



+5 Volt Supply (7)
The +5 V supply is derived directly from one of the main transformer taps that provides low voltage AC. The output of this tap is rectified and regulated.

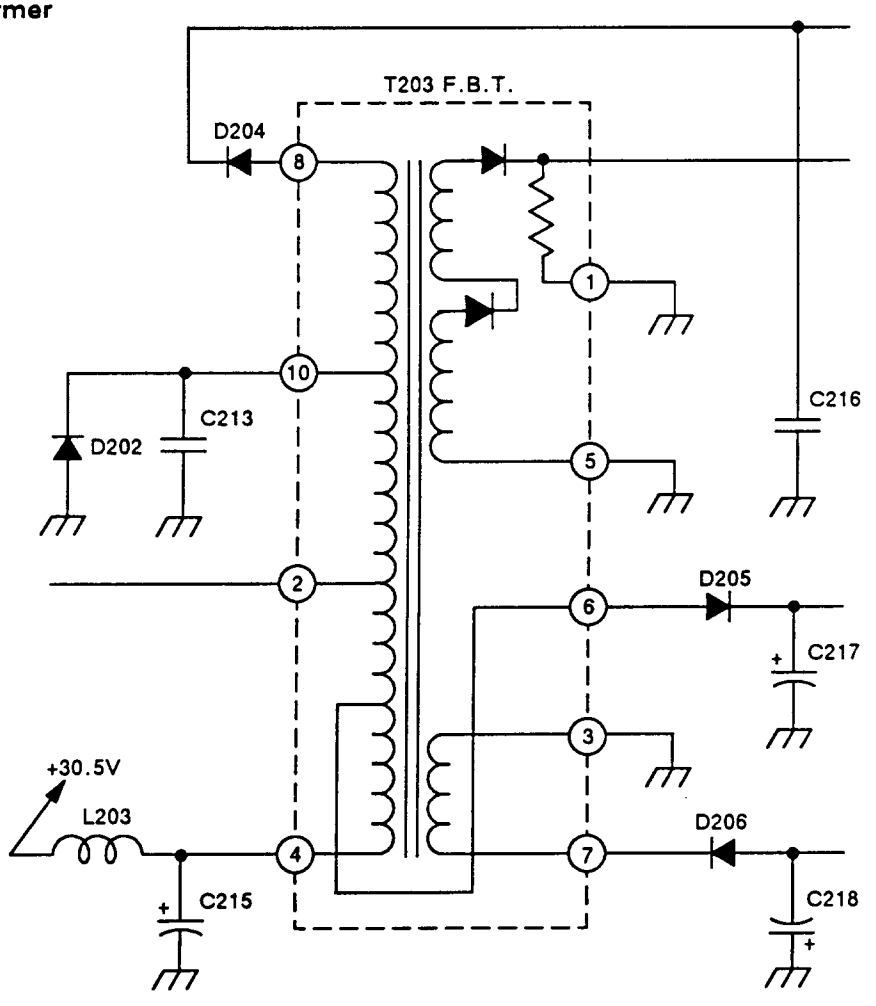
-12 Volt Supply (8)
The -12 V supply is derived directly from one of the main transformer taps. The low voltage AC output is rectified and filtered. The -12 V supply is VEE for the RS-232 drivers.

+15 Volt Supply (9)
The +15 V supply is derived directly from one of the main transformer taps. The low voltage AC output is rectified and filtered. This supply provides filament voltage. Its output is used for +12 V supply.

Flyback Transformer (10)

The flyback transformer steps up the output of the horizontal driver to provide the high voltage for the CRT itself (Figure 4-15).

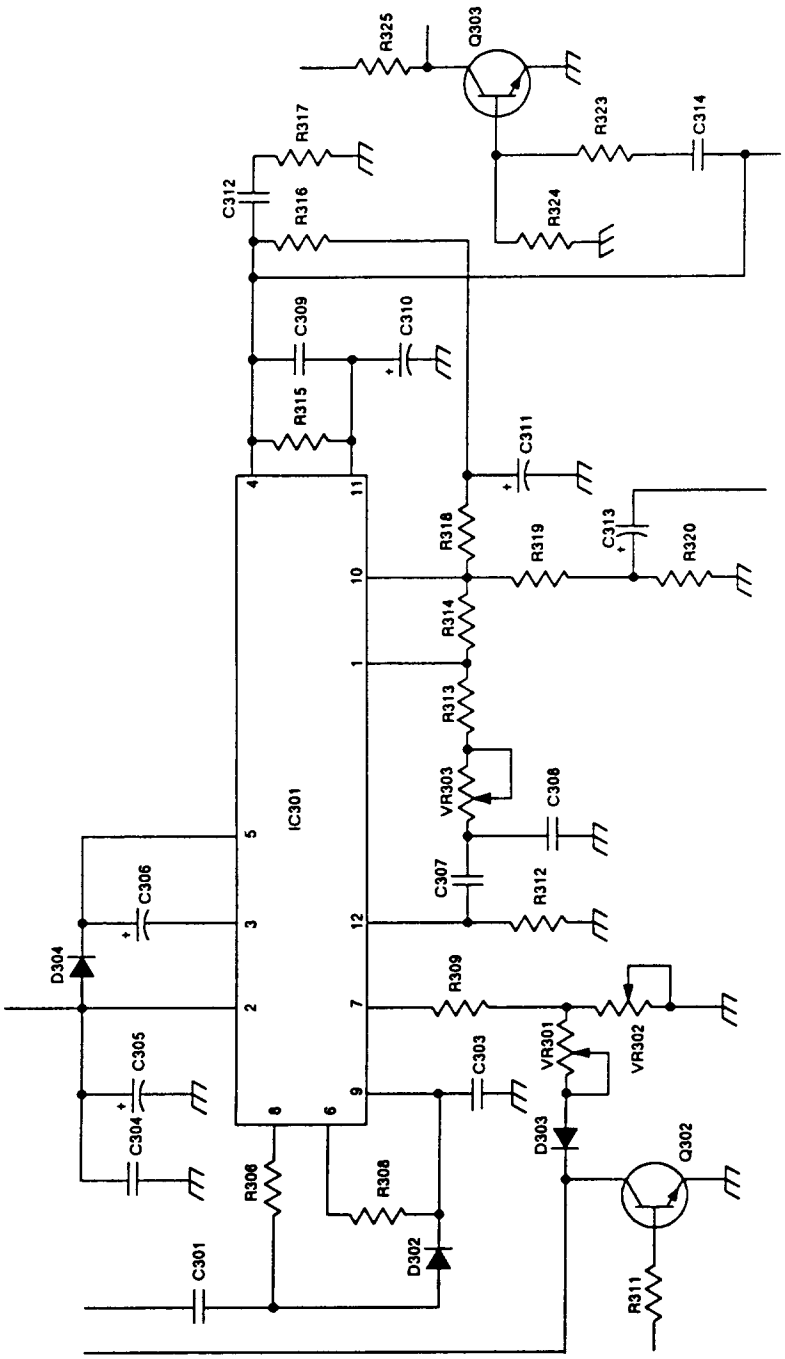
Figure 4-15 Flyback Transformer



Vertical Deflection Circuit (11)

The vertical deflection circuit provides the yoke with the correct vertical drive frequency to ensure that the electron beam scans the face of the CRT at the correct vertical repetition rate. This circuit also controls display height and linearity (Figure 4-16).

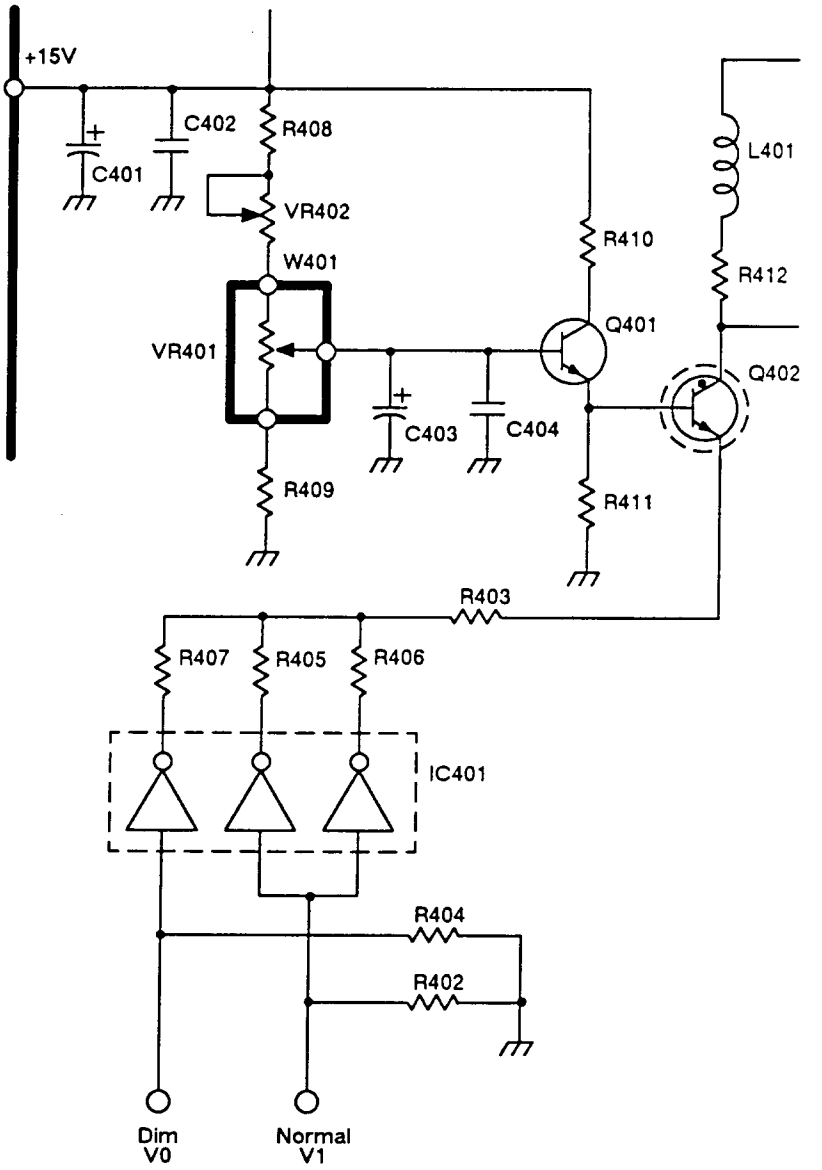
Figure 4-16 Vertical Deflection Circuit



Video Amplifier (12)

The video amplifier varies the voltage on the CRT, pin 2 (Figure 4-17). This variation modulates the beam current. Higher beam current causes a brighter spot on the screen.

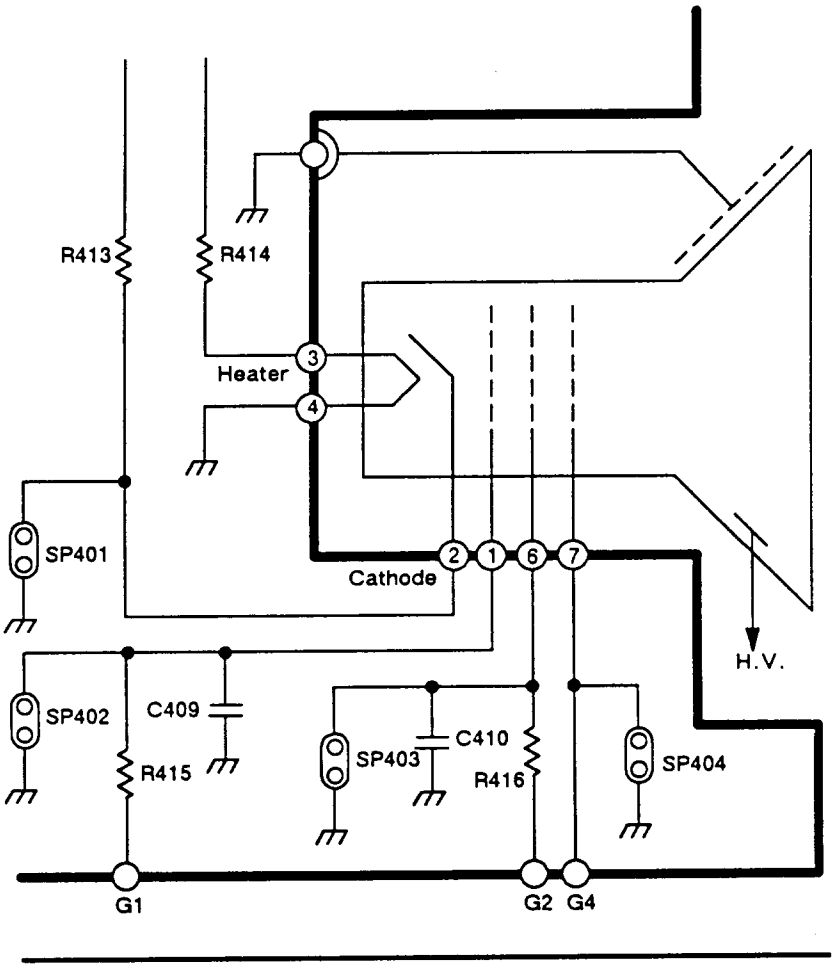
Figure 4-17 Video Amplifier



CRT (13)

The CRT displays data by receiving a modulated electron beam with the video signal while the beam moves across the face of the screen. The horizontal and vertical drive signals determine the rate of movement (Figure 4-18).

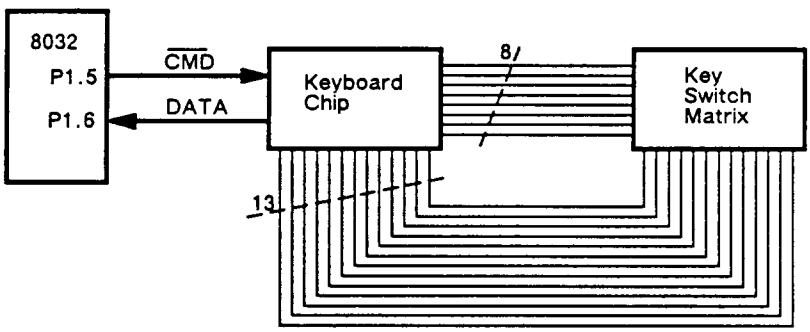
Figure 4-18 CRT



KEYBOARD

The keyboard PCB is arranged as a matrix of up to 13 rows of eight columns each. Each key switch connects one row to one column when that key is pressed. The keyscanner interface chip has 13 open-drain row outputs and eight column inputs with active pullups. The integrated circuit communicates with the external processor on two lines: the command line (-CMD) and the data line (DATA). Figure 4-19 is a block diagram of the keyboard.

Figure 4-19 Keyboard Block Diagram



5 Parts List

PRODUCT SAFETY NOTICE

Many electrical and mechanical parts in this display unit have special safety related characteristics. These are often not evident from visual inspection nor can the protection afforded by them necessarily be obtained by using replacement components rated for higher voltage, wattage, etc. Replacement parts that have these special safety characteristics are identified by a ⚠ mark on the schematics (in Section 6) and in the parts lists (in this section).

▲ **Warning** Replace a failed component only with a component that has the *same* safety characteristics as the recommended replacement listed in this manual. Using another component may create shock, fire, X-radiation, or other hazards. Don't degrade the safety of the display through improper servicing.

TERMINAL ASSEMBLIES

Table 5-1 contains the part numbers for module-level spare parts.

Figure 5-1 illustrates selected assemblies of the terminal.

Figure 5-2 is a silkscreen of the terminal and CRT driver PCBs.

Table 5-2 contains the component-level part numbers for the terminal PCB.

Table 5-3 contains the component-level part numbers for the CRT driver PCB.

Table 5-1 Module-Level Parts List

Part Number		
120-Volt Unit	220-Volt Unit	Description
Major Modules		
840466-01	840494-02	Display Assembly
840468-01	840468-01	Bezel/CRT Assembly
780056-01	780056-01	⚠ CRT (green)
990211-01	990211-02	Terminal (Monitor/Power) PCB
990214-01	990214-02	CRT Driver PCB
419010-01	990214-01	Yoke Assembly (Deflection Coil)
Housing Assemblies		
830118-01	830118-01	Bottom Housing Assembly
710338-02	710338-02	Top Housing
710339-02	710339-02	Bottom Housing
710334-01	710418-01	Bottom Base
710335-01	710335-01	Bottom Disk
710346-01	710346-01	Ball for the Base
710337-03	710337-03	Bezel

Table 5-1 Module-Level Parts List, Continued

Part Number 120-Volt Unit	Part Number 220-Volt Unit	Description
Control Parts		
365505-19	365505-19	Brightness Pot (VR401)
365508-11	365508-11	⚠ Contrast Pot (VR205)
840467-01	840467-01	Control Bracket Assembly
341006-04	341006-04	Power Switch
460016-01	460019-01	Power Switch Knob
460012-01	460020-01	Ball Knob
Harnesses		
940515-01	940515-01	Power Switch Harness
940523-01	940523-01	Contrast Harness
940566-01	940566-01	AC Input Harness
940524-01	940524-01	Brightness Harness
940531-01	940531-01	Keyboard-to-Terminal PCB Harness
940525-01	940525-01	Transistor Harness
Miscellaneous		
728500-01	728500-01	Power Cord (North American)
530013-29	530013-29	⚠ Fuse, 2A/250V
541006-01	541006-01	Battery, 3VDC
840469-01	840469-01	LED Assembly
940526-01	940526-01	Video Cable (from Terminal PCB to CRT Driver PCB)

Figure 5-1 Terminal Assemblies

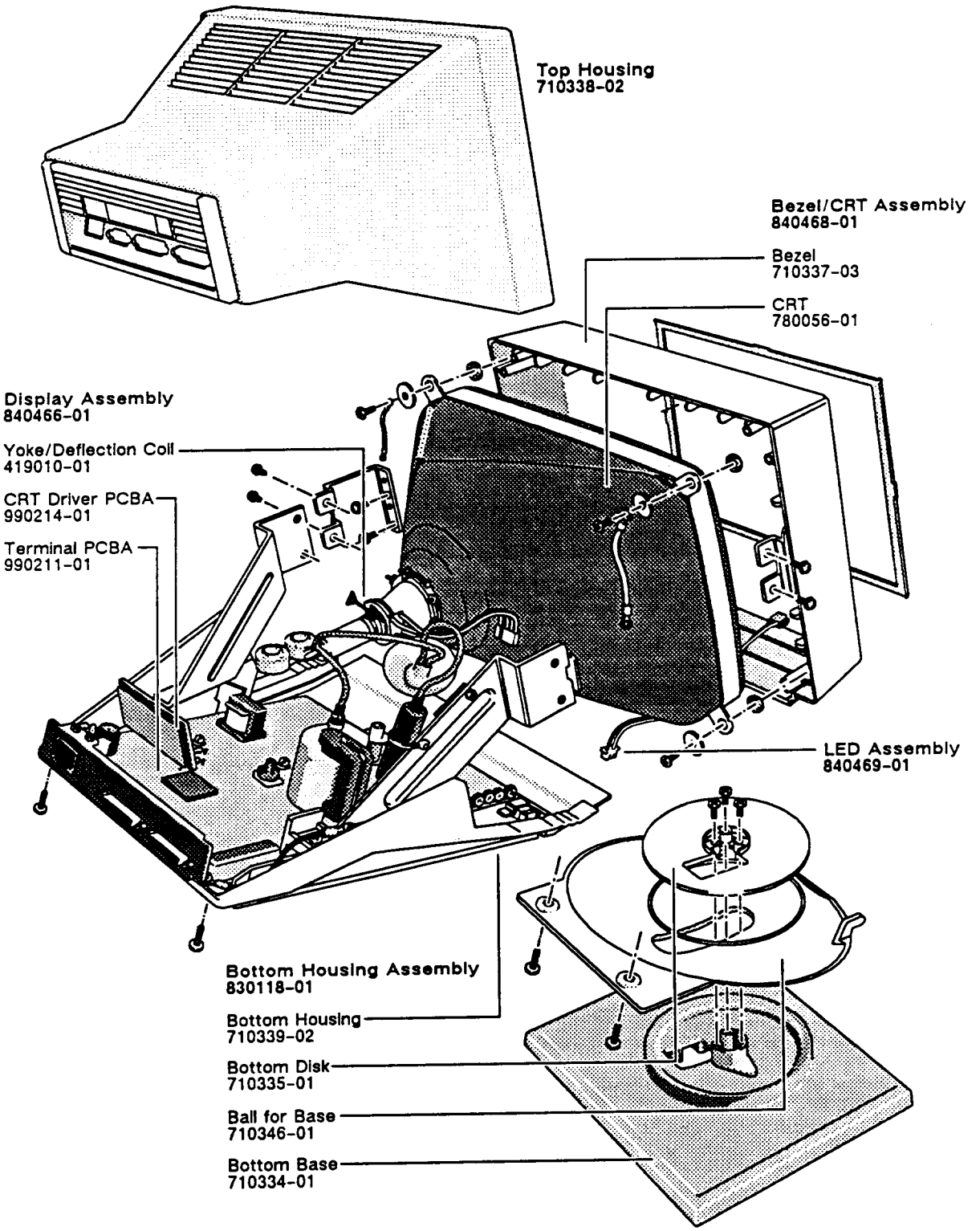


Figure 5-2 Terminal PCB and CRT Driver PCB

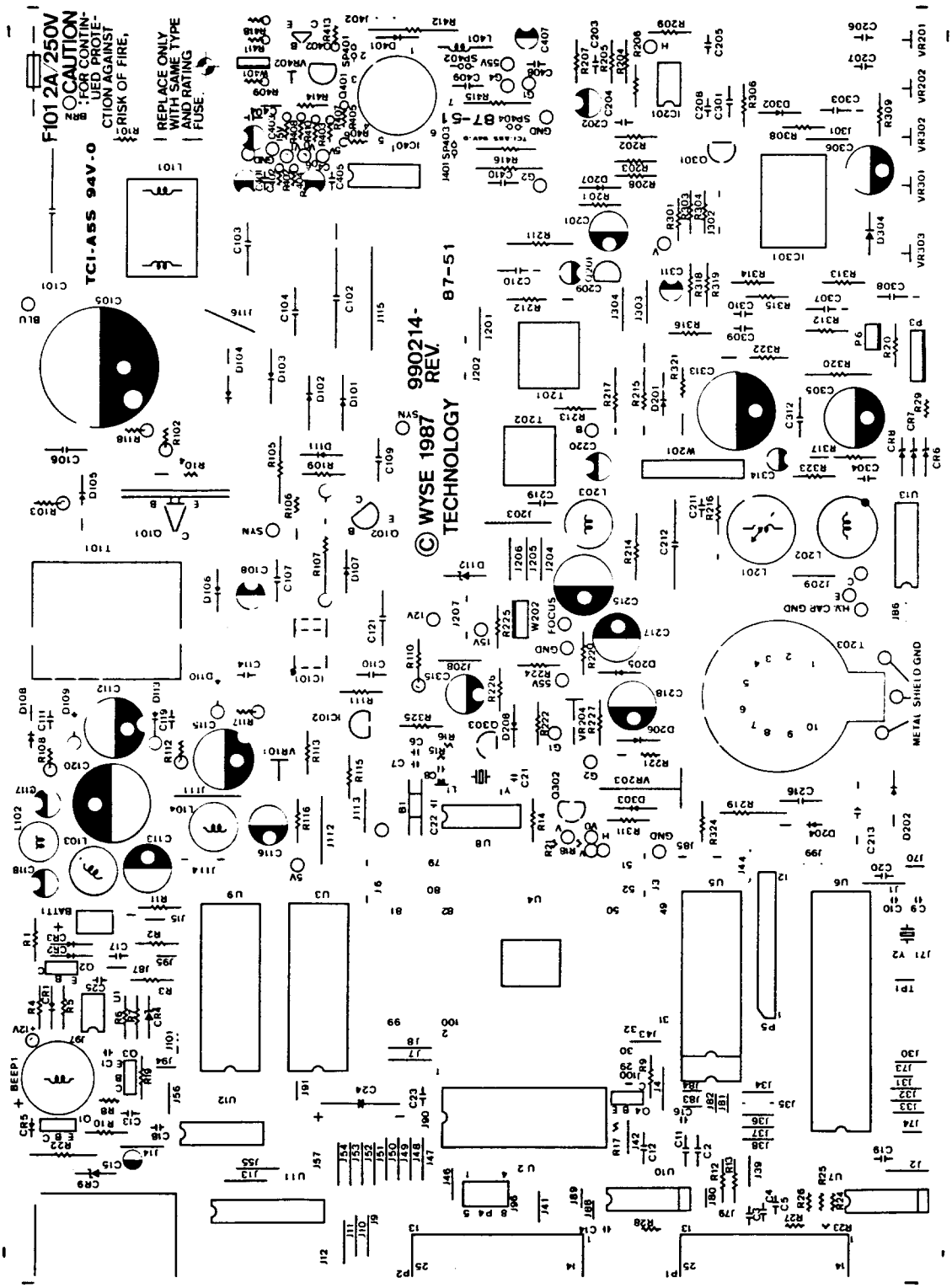


Table 5-2 Component Level Parts List for Terminal PCB*

Location	Description	Part Number
Capacitors		
C1	CAP .1UF 50V	320005-33
C2	CAP 220PF 50V	320010-29
C3-C5	CAP 220PF 50V	320012-17
C6	CAP .01UF 50V	320005-21
C7	CAP .01UF 50V	320005-21
C8	CAP 100PF 50V	320012-13
C9	CAP 33PF 50V	320010-19
C10	CAP 33PF 50V	320010-19
C11	CAP 220PF 50V	320010-29
C12	CAP 220PF 50V	320010-29
C13	CAP 220PF 50V	320012-17
C14	CAP .1UF 50V	320005-33
C15	CAP 22.0UF 16V	315003-15
C16	CAP .1UF 50V	320005-33
C17	CAP .1UF 50V	320031-49
C18	CAP .1UF 50V	320008-33
C19	CAP .1UF 50V	320008-33
C20	CAP .1UF 50V	320008-33
C21	CAP 100PF 50V	320012-13
C22	CAP .1UF 50V	320005-33
C23	CAP .1UF 50V	320008-33
C24	CAP 10UF 16V	310034-13
C25	CAP 1UF 50V	320008-45
C101	CAP .47 UF 250V	329001-11
C102	CAP .1 UF 250V	329001-07
C103	CAP 4700PF 250V	320050-87
C104	CAP 4700PF 250V	320050-87
C105	CAP 220UF 200V (120-volt unit only)	310098-21
C105	CAP 100UF 400V (220-volt unit only)	310201-19
C106	CAP .01UF 1KV	320040-49
C107	CAP .1 UF 100V	320505-15
C108	CAP 22UF 25V	310004-15
C109	CAP .047UF 100V	320501-13
C110	CAP .001UF 100V	320580-01
C111	CAP .01UF 100V	320034-49
C112	CAP 680UF 10V	310002-24
C113	CAP 470UF 10V	310002-23
C114	CAP .01UF 100V	320034-49
C115	CAP 680UF 25V	315004-24
C116	CAP 330UF 25V	315004-22
C117	CAP 100UF 25V	310004-19
C118	CAP 100UF 25V	310004-19
C119	CAP 560PF 500V	320036-34
C120	CAP 470UF 50V	315006-23
C121	CAP .0047UF 250V	329003-06
C201	CAP 100UF 16V	315003-19
C202	CAP 3300PF 50V	320563-07
C203	CAP 2200PF 50V	320563-05
C204	CAP 1UF 50V	315006-07
C205	CAP .01UF 50V	320563-13
C206	CAP 2200PF 50V	320563-05
C207	CAP .022UF 50V	320563-17
C208	CAP .015UF 50V	320563-15
C209	CAP 10UF 25V	310004-13
C210	CAP .1UF 50V	320563-25
C211	CAP 180PF 500V	320036-28
C212	CAP 1.8UF 100V	320505-28
C213	CAP 8200PF 630V	320573-12
C215	CAP 220UF 50V	315006-21
C216	CAP .01UF 1KV	320046-49
C217	CAP 10UF 160V	315010-13
C218	CAP 10UF 160V	315010-13
C219	CAP .01UF 1KV	320046-49
C220	CAP 10UF 50V	315006-13
C301	CAP 2200PF 50V	320563-05

* Part number 990211-01 (Logic Board and Power Supply)

Table 5-2 Component Level Parts List for Terminal PCB* Continued

Location	Description	Part Number
C303	CAP .1UF 50V	320563-25
C304	CAP 0.1UF 25V	320031-61
C305	CAP 680UF 25V	315004-24
C306	CAP 100UF 35V	315005-19
C307	CAP 0.1UF 50V	320604-25
C308	CAP 0.1UF 50V	320604-25
C309	CAP 390PF 50V	320030-32
C310	CAP 4700PF 50V	320030-45
C311	CAP 22UF 16V	315003-15
C312	CAP .1UF 50V	320563-25
C313	CAP 3300UF 16V	315003-28
C314	CAP 10UF 50V	315006-13
C315	CAP 4.7UF 160V	315010-11
Diodes		
CR1-CR3	DIODE IN4148	280001-01
CR4	DIODE ZENER 2.4V	281305-12
CR5	DIODE IN4148	280001-01
CR6-CR8	DIODE ZENER 6.2V 1/2W	281305-08
CR9	DIODE ZENER 5.1V 1W	281307-01
D101-D104	DIODE 1N5397	283203-01
D105	RECT RGP10M FST 1KV	283714-01
D106-D108	DIODE IN4937 1A/600V	283701-01
D109	DIODE FAST 2A/50V	284520-01
D110	DIODE RGP30G	283704-01
D111	DIODE IN4937 1A/600V	283701-01
D112	DIODE ZENER 12EB3	281305-15
D113	DIODE FAST 400V 3A	284523-01
D201	DIODE SRP100G	283709-01
D202	RECT RGP30J 3A/600V	283704-02
D204-D206	DIODE RGP5100	283703-01
D207	DIODE IN4148	280001-01
D208	DIODE IN4148	280001-01
D302	DIODE IN4148	280001-01
D303	DIODE IN4148	280001-01
D304	DIODE RGP5020	283703-02
Integrated Circuits		
IC101	IC 4N35 (120-volt unit only)	290000-01
IC101	IC MOC604A (220-volt unit only)	290003-01
IC102	IC SHUNT REGULATOR (TL431C)	221004-01
IC201	IC MC1391P	222500-01
IC301	IC TDA 1170N	222504-01
U1	IC LM393	220501-01
U2, U3	IC 6264P-10 SRAM 8KX8,100NS	192004-03
U4	IC SLA7490 GATE ARRAY	211009-01
U6	IC 8032 8-BIT U CONT	202004-01
U7	IC 1489A	226001-01
U8	IC 74F04	171302-01
U9	IC 8464 SRAM 8KX8 100NS LOWPWR	192007-02
U10	IC 1488	226000-01
U11	IC 74LS377	170096-01
U12	IC 74LS365A 6X BVF/DRVR	170089-01
U13	IC 74LS368	170092-01
U5	IC 27256 EPROM 250NS, ASSY, INTL	250412-01
U5	FIRMWARE, DOMESTIC	250330-01
Resistors		
R1	RES 3.3 KOHM 1/4W	370020-85
R2	RES 820 OHM 1/4W	370020-71
R3	RES 1.6 KOHM 1/4W	370020-78
R4	RES 43 OHM 1/4W	370020-40
R5	RES 510 OHM 1/4W	370020-66
R6	RES 1.8 KOHM 1/4W	370020-79
R7	RES 1.0 KOHM 1/4W	370020-73

Table 5-2 Component Level Parts List for Terminal PCB* Continued

Location	Description	Part Number
R8	RES 3.3 KOHM 1/4W	370020-85
R9	RES 510 OHM 1/4W	370020-66
R10	RES 1.8 KOHM 1/4W	370020-79
R11-R13	RES 4.7 KOHM 1/4W	370020-89
R14	RES 62 OHM 1/4W	370020-44
R15	RES 220 OHM 1/4W	370009-57
R16	RES 220 OHM 1/4W	370009-57
R17	RES 510 OHM 1/4W	370009-66
R18	RES 100 OHM 1/4W	370009-49
R19	RES 1.0 KOHM 1/4W	370020-73
R20	RES 220 OHM 1/4W	370020-57
R21	RES 100 OHM 1/4W	370009-49
R22	RES 100 OHM 2W	370617-49
R23-R29	RES 47 OHM 1/4W	370009-41
R101	RES 3.9 OHM 3W	370914-39
R102	RES 100 KOHM 1W	370006-25
R103	RES 22 KOHM 5W	370628-09
R104	RES 1.0 KOHM 1/4W	370020-73
R105	RES 0.82 OHM 1W (120-volt unit only)	370912-23
R105	RES 1.8 OHM 1W (220-volt unit only)	370611-07
R106	RES 75 OHM 1/4W	370020-46
R107	RES 33 OHM 3W	370903-61
R108	RES 20 OHM 1/2W	370003-32
R109	RES 360 OHM 1/4W	370020-62
R110	RES 220 OHM 2W	370007-33
R111	RES 24 KOHM 1/4W	370021-10
R112	RES 20 OHM 1/2W	370003-32
R113	RES 56 OHM 1/4W	370020-43
R114	RES 4.7 KOHM 1/4W	370020-89
R115	RES 24 KOHM 1/4W	370021-10
R116	RES 2 KOHM 1/4W	370020-80
R117	RES 20 OHM 1/2W	370003-32
R201	RES 330 OHM 1/4W	370020-61
R202	RES 2.7 KOHM 1/4W	370020-83
R203	RES 1.8 KOHM 1/4W	370020-79
R204	RES 4.7 KOHM 1/4W	370020-89
R205	RES 12 KOHM 1/4W	370021-03
R206	RES 56 KOHM 1/4W	370021-19
R207	RES 10 KOHM 1/4W	370021-01
R208	RES 1.2 KOHM 1/4W	370020-75
R209	RES 1.0 KOHM 1/4W	370020-73
R211	RES 39 OHM 2W	370617-39
R212	RES 91 OHM 1/2W	370022-48
R213	RES 12 OHM 1/4W	370020-27
R214	RES 22 KOHM 1/2W	370023-09
R215	RES 680 OHM 2W	370617-69
R216	RES 330 OHM 1W	370613-61
R217	RES 1.5 OHM 1W	370613-05
R219	RES 1.0 MOHM 1/2W	370023-49
R220	RES 22 KOHM 1/4W	370021-09
R221	RES 100 KOHM 1/4W	370021-25
R222	RES 100 KOHM 1/4W	370021-25
R224	RES 27 KOHM 1/4W	370021-11
R225	RES 220 KOHM 1/4W	370021-33
R226	RES 330 KOHM 1/4W	370021-37
R227	RES 33 KOHM 1/4W	370021-13
R301	RES 4.7 KOHM 1/4W	370020-89
R303	RES 2.7 KOHM 1/4W	370020-83
R304	RES 1.0 KOHM 1/4W	370020-73
R306	RES 10 KOHM 1/4W	370021-01
R308	RES 240 KOHM 1/4W	370021-34
R309	RES 120 KOHM 1/4W	370021-27
R310	RES 470 OHM 1/4W	370020-65
R311	RES 1.0 KOHM 1/4W	370020-73
R312	RES 620 KOHM 1/4W	370021-44
R313	RES 39 KOHM 1/4W	370021-15
R314	RES 43 KOHM 1/4W	370021-16

Table 5-2 Component Level Parts List for Terminal PCB* Continued

Location	Description	Part Number
R315	RES 100 KOHM 1/4W	370021-25
R316	RES 1.8 KOHM 1/4W	370020-79
R317	RES 3.3 OHM 1/4W	370020-13
R318	RES 6.8 KOHM 1/4W	370020-93
R319	RES 4.3 KOHM 1/4W	370020-88
R320	RES 1 OHM 1W	370613-01
R321	RES 220 OHM 1W	370613-57
R322	RES .33 OHM 1W	370603-13
R323	RES 330 OHM 1/4W	370020-61
R324	RES 1.0 KOHM 1/4W	370020-73
R325	RES 1.0 KOHM 1/4W	370020-73
VR101	RES VAR. 500 OHM LINEAR	360006-04
VR201	POT TRM. 10 KOHM 1/4W	360024-22
VR202	POT TRM. 1 KOHM 1/4W	360024-25
VR203	RES VAR. 2 M	360009-18
VR204	POT TRM. 100 KOHM .5W	360033-18
VR205	⚠ POT RTR 50 KOHM .05W	365508-11
VR301	POT TRM. 50 KOHM 1/4W	360024-11
VR302	POT TRM. 100 KOHM .25W	360024-23
VR303	POT TRM. 10 KOHM 1/4W	360024-09
VR401	POT RTR 10 KOHM .05W	365505-19
Transistors		
L101	TRANSFRMR LINE FILTER	424513-01
Q1	TRANSISTOR 2N3904	270010-01
Q2-Q4	TRANSISTOR 2N3904	270010-01
Q101	XSTR NPN 2SC3446 (120-volt unit only)	272030-01
Q101	XSTR 2SC2979 (220-volt unit only)	272018-01
Q102, Q201	TRANSISTOR 2SC1213	270018-01
Q301, Q302	TRANSISTOR 2SC458 C/D/2SC945	270006-01
Q303	TRANSISTOR 2SC1213	270018-01
T101	XFMR PW UL/CSA EE-35 (120-volt unit only)	421543-01
T101	XFMR VDE (220-volt unit only)	421544-01
T201	XFMR HOR DR UL/CSA/VDE TR=0.2	423035-01
T202	XFMR FOCUS UL/CSA/VDE EE-16	429015-01
T203	⚠ XFMR FBT UL/CSA/VDE FH=31.37KHZ	429014-01
Inductors		
L1	INDUCTOR 0.22UH	410000-01
L102	COIL CHOKE 10UH	410502-01
L103, L104	COIL CHOKE 100UH	410504-01
L201	COIL HOR W 7-31UH	411018-01
L202	COIL HOR LIN 14.4UH	411020-01
L203	COIL CHOKE 100UH	410504-01
Miscellaneous		
Y1	CRYSTAL 48 MHZ	390000-48
Y2	CRYSTAL 11 MHZ	390000-24
	BEEPER AUDIO TRANSDUCER	522000-01
	BATTERY LITHIUM 3VDC	541006-01
	SW PW PUSH 4A/250V UL/CSA/VDE	341006-01
	CONN PLG AC 6100-41 (FELLER)	560850-01
	AC SOCKET ASSY	840470-01
	HARNESS POWER SWITCH	940515-01
	HARNESS COIL CORE	940549-01
	HARNESS TRANSISTOR	940525-01
	CABLE VIDEO	940526-01

Table 5-3 CRT Driver PCB Parts List

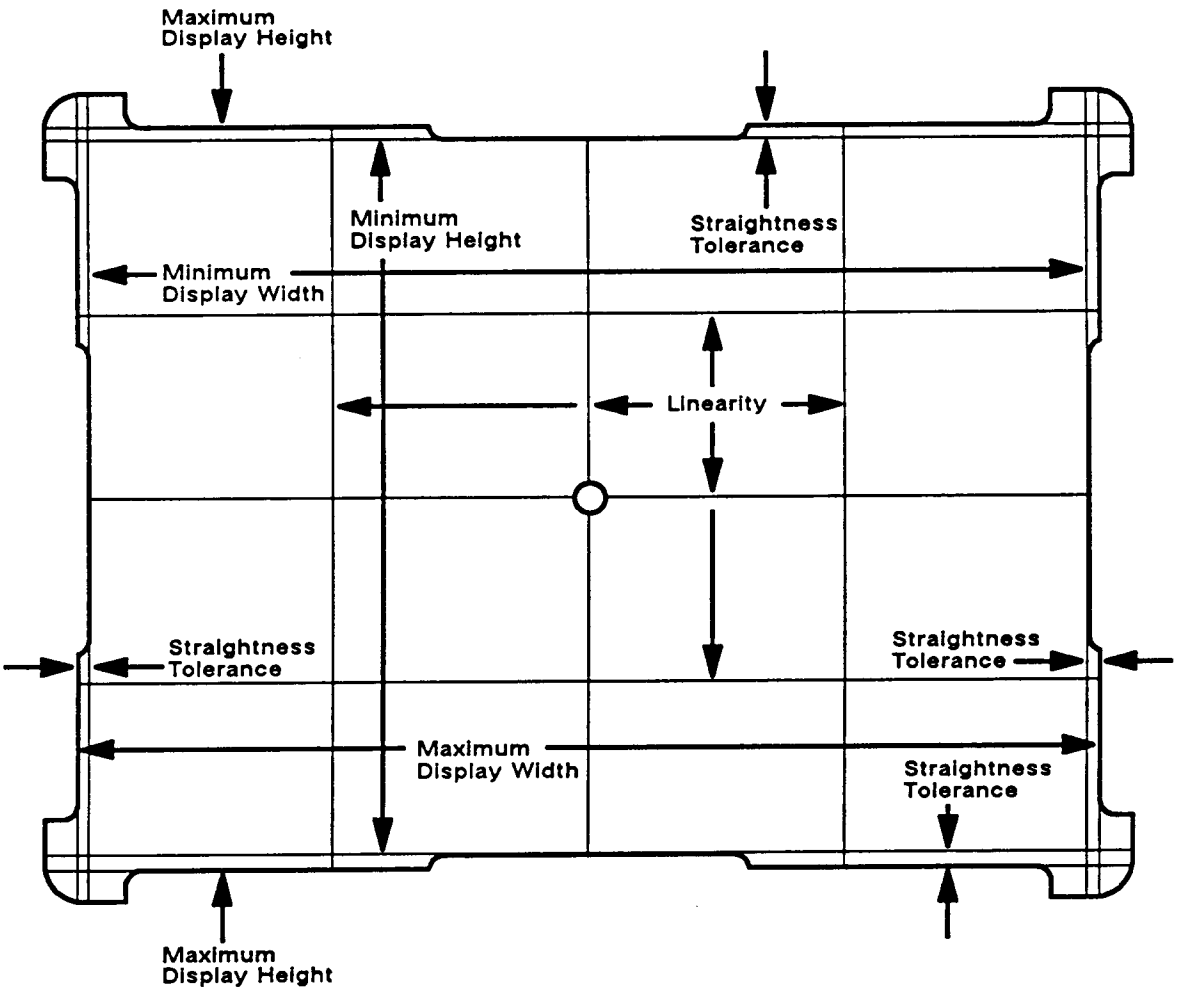
Location	Description	Part Number
	PCBA CRT DR	990213-01
	SHIELDING DRIVE PCB	700475-01
	SOCKET CRT	552507-01
IC401	IC 74S05	170004-11
Q401	TRANSISTOR 2SC1213	270018-01
Q402	TRANSISTOR NPN 800 MHZ 100V	270025-01
D401	DIODE IN4148	280001-01
Resistors		
R402	RES 1 KOHM 1/4W	370009-73
R403	RES 52 OHM 1/4W	370009-42
R404	RES 1 KOHM 1/4W	370009-73
R405	RES 82 OHM 1/4W	370009-47
R406	RES 82 OHM 1/4W	370009-47
R407	RES 62 OHM 1/4W	370009-44
R408	RES 18 KOHM 1/4W	370010-07
R409	RES 1 KOHM 1/4W	370009-73
R410	RES 100 OHM 1/4W	370009-49
R411	RES 1 KOHM 1/4W	370009-73
R412	RES 680 OHM 3W	370621-69
R413	RES 100 OHM 1/4W	370009-49
R414	RES 39 OHM 1/4W	370020-39
R415	RES 1 KOHM 1/4W	370022-73
R416	RES 100 KOHM 1/4W	370023-25
VR402	POT 5 KOHM 1/4W	360034-07
Capacitors		
C401	CAP 10UF 25V	310004-13
C402	CAP 0.1UF 25V	320031-61
C403	CAP 10UF 25V	310004-13
C404	CAP 0.1UF 25V	320031-61
C405	CAP 0.1UF 25V	320031-61
C406	CAP 10UF 25V	310004-13
C407	CAP 10UF 160V	315010-13
C408	CAP 0.01 100V	320034-49
C409	CAP 1000PF 1KV	320039-37
C410	CAP 0.01UF 1KV	320046-49
Miscellaneous		
L401	COIL PKING 3.3UH K	412501-07
SP403,SP404	CAP SPARK GAP	321102-01
SP401,SP402	CAP SPARK GAP	321104-01
	FILTER CRT	710359-01

Appendix A

Display Inspection with the Reticle

The video inspection reticle, a sheet of milled plastic with markings, helps you measure the display to determine whether or not the display is within specification. Figure A-1 shows the reticle and its markings.

Figure A-1 Video Inspection Reticle



DEFINITIONS

Before checking the display, make sure you understand the following terms:

Bezel	The front-piece of the display case that frames the face of the CRT.
Display	The portion of the screen where the video display alignment pattern appears.
Linearity	A comparison of character height and width ranges in the display. You can check both vertical and horizontal linearity by comparing character height and width within the display. True linearity results in characters that are the same height and width range everywhere. See Section 3 for linearity tolerances.
Pincushion and Barrel Distortion	Distortion that results if deflection is not uniform at the raster edges when compared with the center of the display. Scan lines bowed inward are called "pincushion distortion." Scan lines bowed outward are called "barrel distortion."
Video Display Alignment Pattern	A test pattern to measure display alignment.

BEFORE YOU START

Before you check the alignment, do the following:

1 At least 30 minutes before you check the display, turn on the terminal. This warm-up period settles the display and gives you an accurate test pattern to measure.

2 Generate the terminal test pattern (see Section 3).

3 Point the neck of the CRT toward magnetic north to minimize the effects of the earth's magnetic field.

4 Have the video display reticle on hand to inspect the display.

CHECKING THE DISPLAY WITH THE RETICLE

This section contains directions for using the reticle to check width, height, straightness, pincushioning, centering, and linearity.

Checking Width

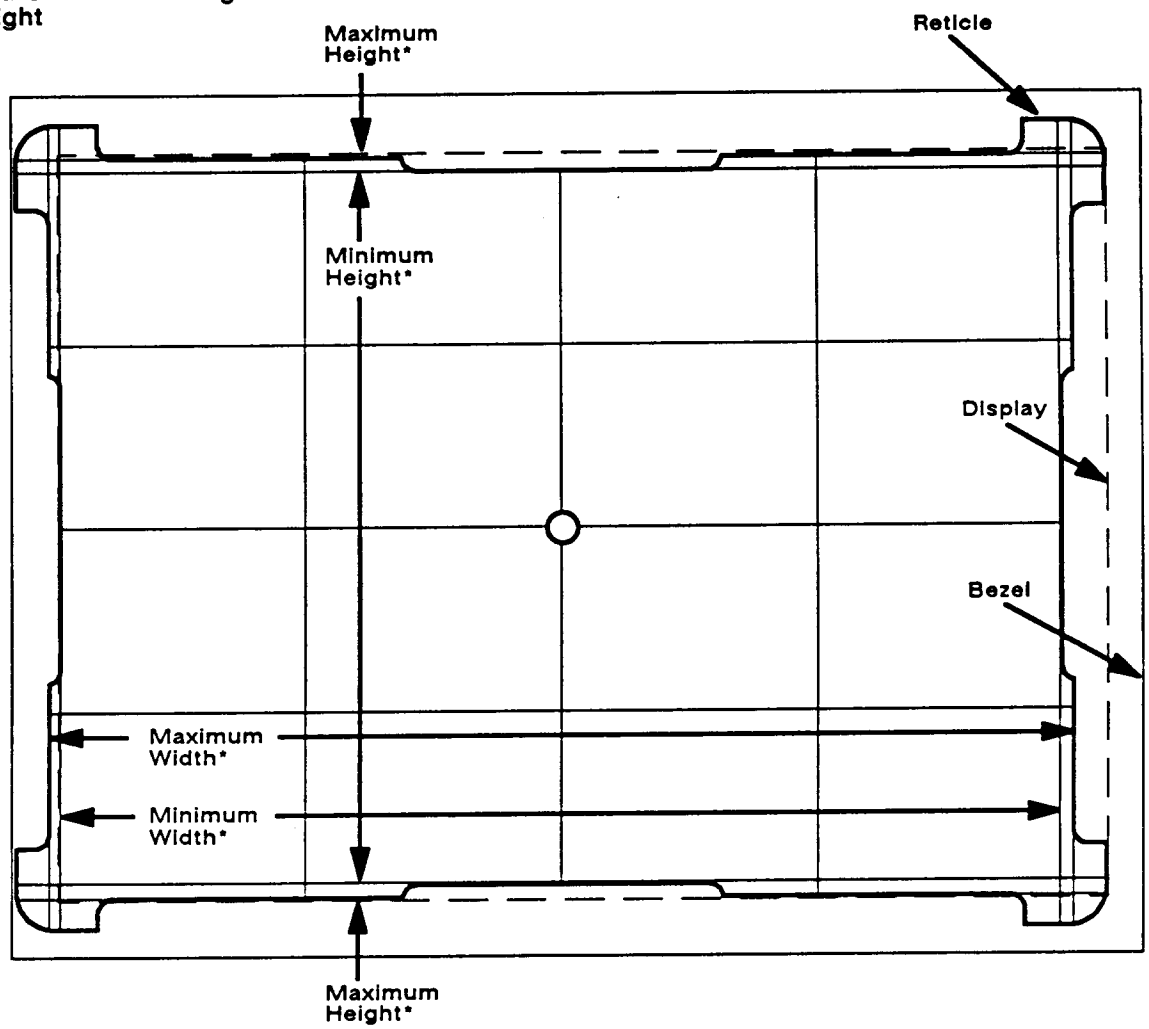
To check the display's width, follow these steps:

1 Rest the reticle along the lower horizontal edge of the bezel.

2 Check the left vertical edge, then the right vertical edge of the alignment pattern by moving the reticle along the edge of the bezel. Both edges should fall between the minimum and maximum display width bands on the reticle (see Figure A-2).

3 If either edge falls outside the bands, adjust the display (see the alignment instructions in Section 3).

Figure A-2 Checking Width and Height



*The display must lie between these lines

Checking Height

To check the display height, follow these steps:

1 Rest the reticle on the left vertical edge of the bezel.

2 Move the reticle up and down along the edge. Check the top edge, then the bottom edge of the alignment pattern. Both edges should fall between the minimum and maximum display height bands on the reticle (see Figure A-2).

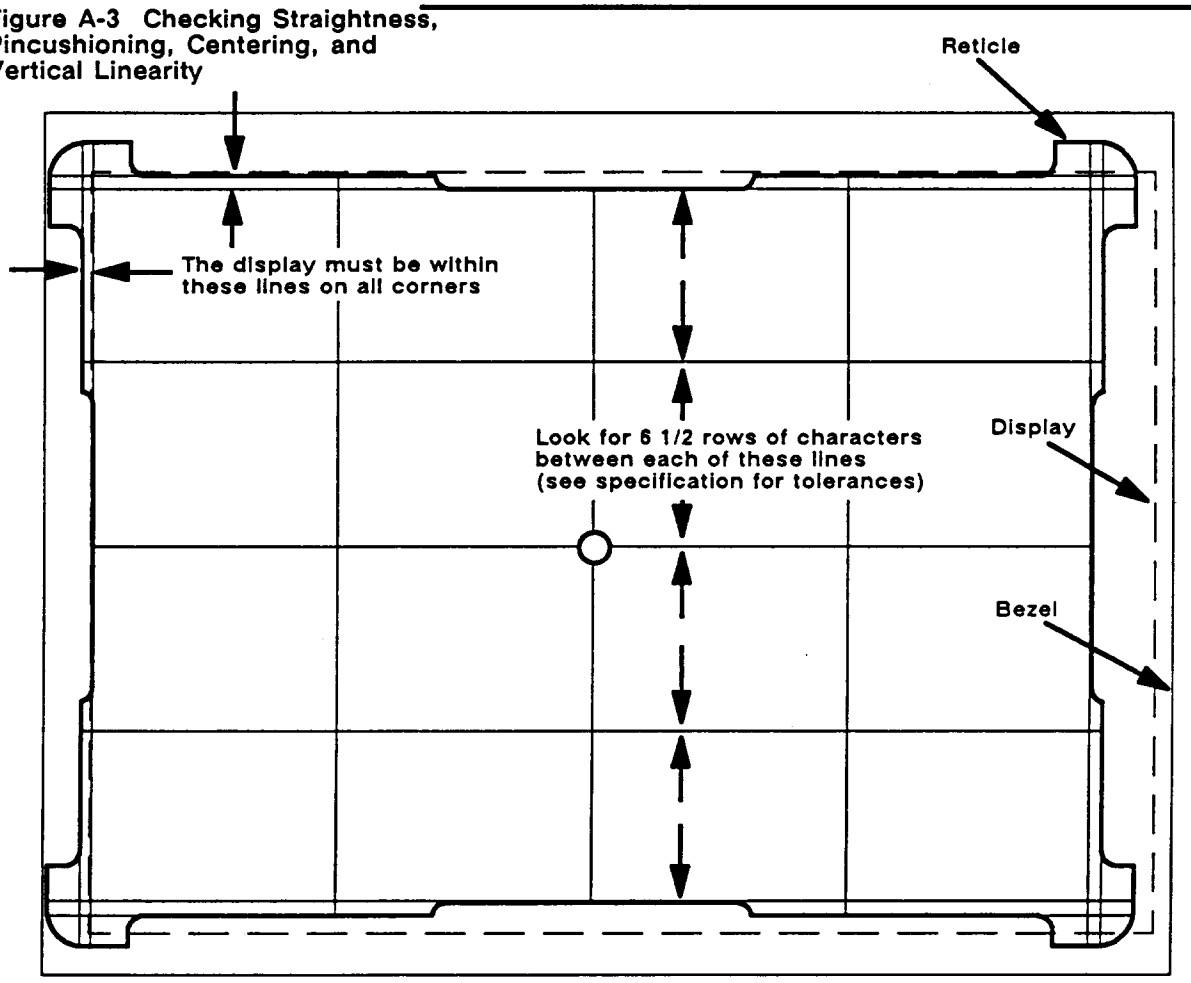
3 If one or the other edge falls outside the bands, adjust the display (see the alignment instructions in Section 3).

Checking Straightness and Pincushioning

To check straightness and pincushioning, follow these steps:

1 Move the reticle along a horizontal edge of the bezel. Check the right vertical edge, then the left vertical edge against the straightness lines etched on the perimeter of the reticle (see Figure A-3).

Figure A-3 Checking Straightness, Pincushioning, Centering, and Vertical Linearity


Reticle
The display must be within these lines on all corners
Look for 6 1/2 rows of characters between each of these lines (see specification for tolerances)
Display
Bezel

2 Move the reticle along a vertical edge of the bezel. Check the top edge, then the bottom edge against the straightness lines etched on the perimeter of the reticle.

3 Position the upper right corner of the display between the etched markings on the upper right corner of the reticle. The display corner edge should fall within the scribed markings on the corner of the reticle.

4 Repeat the same procedure for the other corners of the display.

5 If an edge or corner doesn't fall within the markings, adjust the display (see Section 3).

Checking Centering

To check the centering, follow these steps:

1. Hold the reticle over the center of the alignment pattern.
2. Move the reticle against the right edge of the bezel, then the left edge of the bezel. If the right and then the left edges of the alignment pattern are inside the etched lines on the left and right sides of the reticle, the display is horizontally centered (see Figure A-3).
3. If the alignment pattern on the display isn't horizontally centered, adjust the display (see Section 3).
4. Move the reticle against the top bezel edge, then the bottom bezel edge. If the top and then the bottom edges of the alignment pattern are inside the etched lines on the top and bottom sides of the reticle, the display is vertically centered.
5. If the alignment pattern on the display isn't vertically centered, adjust the display (see Section 3).

Verifying Linearity

To verify linearity, follow these steps:

1. Place the right side of the reticle against the right edge of the bezel (see Figure A-3).
2. Count the number of rows between each etched line on the reticle. The numbers should be within ±15 percent of each other (90 percent of one line).
3. If numbers of rows between each line etched on the reticle aren't equal, adjust the display (see Section 3).

Appendix **B**

Specifications

Power Requirements	Line voltage	90 to 132 VAC (North American) 180 to 270 VAC (International)
	Line frequency	47 to 63 Hz
	Power consumption	45 watts
	Fuse	250 V, 2.0 ampere (slow blow)
Operating Requirements	Ambient air temperature	0 to +40 degrees Centigrade
	Nonoperating air temperature	−40 to +70 degrees Centigrade
	Operating altitude	10,000 feet, ASL
	Nonoperating altitude	40,000 feet, ASL
	Environmental humidity	10 to 95%, noncondensing
Scan Frequency	Horizontal	31.372 kHz
	Vertical	59.999 Hz and 78.041 Hz
Retrace Time	Horizontal	4.1 us (maximum)
	Vertical	500.0 us (maximum)
Linearity	Horizontal and Vertical	10%

Resolution

	60 Hz	78 Hz
Horizontal, 80 columns	800 dots	800 dots
Horizontal, 132 columns	1188 dots	1188 dots
Vertical	416 lines	338 lines

Display Format	Horizontal	80 or 132 columns
	Vertical	26 lines
Character Cells and Matrices	60 Hz, 80 columns, 26 lines	
	Character cell	10x16 (with 3-dot descenders)
	Character matrix	7x12
	60 Hz, 132 columns, 26 lines	
	Character cell	9x16 (with 3-dot descenders)
	Character matrix	7x12
	78 Hz, 80 columns, 26 lines	
	Character cell	10x13 (with 2-dot descenders)
	Character matrix	7x10
	78 Hz, 132 columns, 26 lines	
	Character cell	9x13 (with 2-dot descenders)
	Character matrix	7x10
Display Size	Horizontal	237 mm, ±5 mm
	Vertical	172 mm, ±5 mm

Centering	Margin tolerance	
	Horizontal	±7.00 mm
	Vertical	±6.00 mm
Pincushion and Tilt	Margin tolerance	
	Horizontal	±1.86
	Vertical	±1.5 mm
Display Intensity, Nominal	P31 Green	
	Full bright	70 fL, ±2 fL
	Normal	40 fL, ±2 fL
	P134 Amber	
	Full bright	35 fL, ±2 fL
	Normal	16 fL, ±2 fL
	P188 White	
	Full bright	50 fL, ±2 fL
	Normal	30 fL, ±2 fL
Dimensions	Terminal	13.5 in H x 14 in W x 13.5 in D (322 mm x 350 mm x 322 mm)
	Screen	14 in diagonal, flat (35 cm)
	ASCII/ANSI Keyboards	2.25 in H x 17.25 in W x 7.6 in D (5.77 cm x 44.23 cm x 19.48 cm)
	Enhanced PC-Style Keyboard	2.25 in H x 18.7 in W x 7.6 in D (5.77 cm x 4.76 cm x 19.48 cm)
Shipping Weight	20 lbs	
Measurement Direction	CRT neck pointing west	
Warmup Time	30 minutes	
Movement	Tilt and swivel	
Phosphor	P31 green, P134 amber, P188 white	
Character Attributes	Normal, dim, blink, blank, underline, reverse, underscore, and combinations; hidden or nonhidden	
Line Attributes	Double wide, double high and combinations; dim, reverse	
Cursor Attributes	Block, underline, with or without blinking	
Regulatory Approvals	FCC (Meets FCC rules and regulations, Part 15, Subpart J, Class A)	
	UL (Meets US specification number 478 for EDP units and systems)	
	CSA (Meets CSA specification C22.2, number 154)	
	VDE/IEC (Designed to meet IEC Standard 380/VDE Standard 806, and VFG 1046/1984 VDE Level B specifications. Pending approval. [International version only])	

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6 Schematics

PRODUCT SAFETY NOTICE

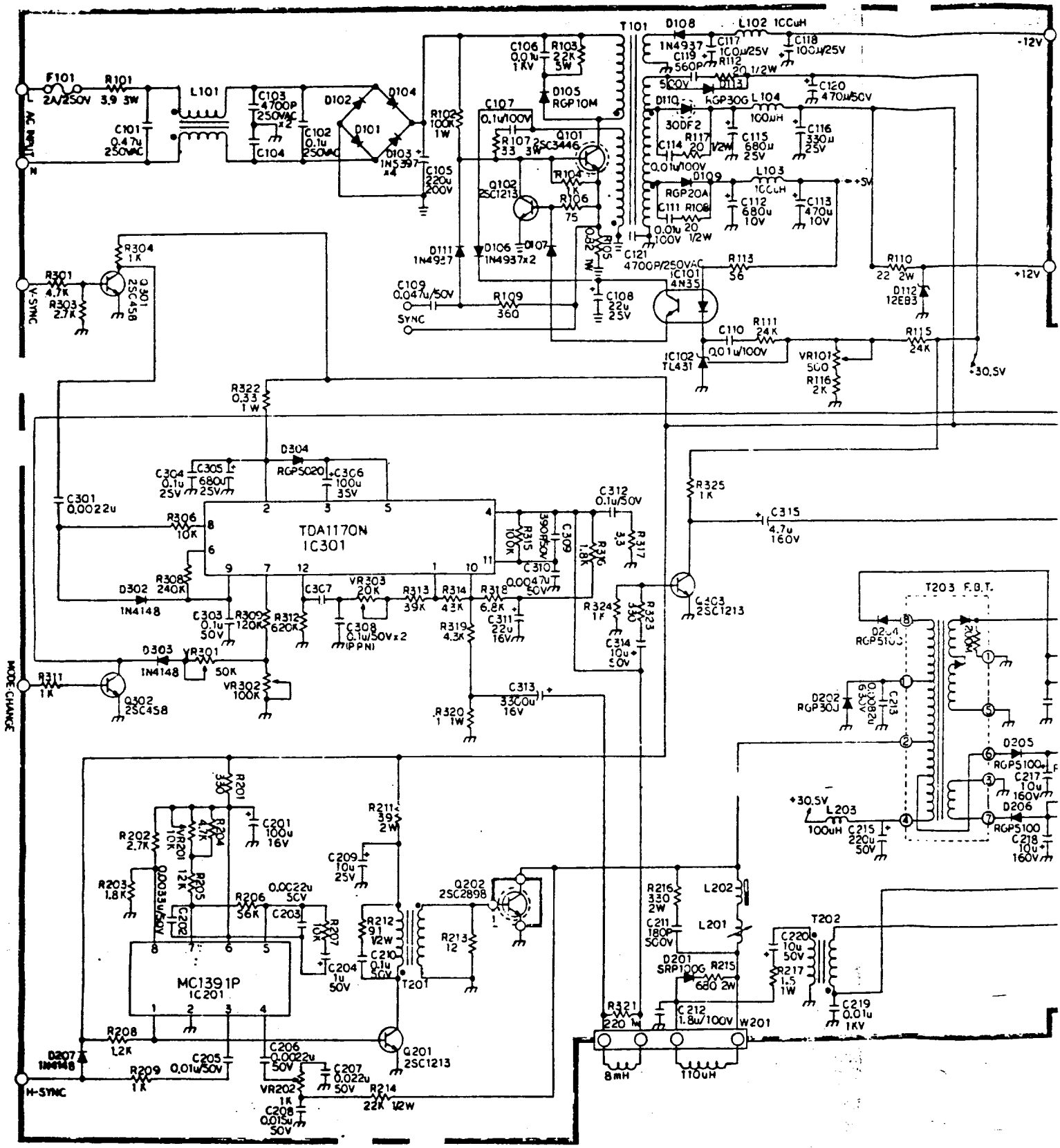
Many electrical and mechanical parts in this display unit have special safety related characteristics. These are often not evident from visual inspection nor can the protection afforded by them necessarily be obtained by using replacement components rated for higher voltage, wattage, etc. Replacement parts that have these special safety characteristics are identified by a ⚠ mark on the schematics (in this section) and in the parts lists (in Section 5).

▲ **Warning** Replace a failed component only with a component that has the *same* safety characteristics as the recommended replacement listed in this manual. Using another component may create shock, fire, X-radiation, or other hazards. Don't degrade the safety of the display through improper servicing.

SCHEMATICS

This section contains the schematic diagrams for the terminal logic/power supply PCB and the CRT drive PCB.

Schematic	Part Number	Page
Logic/Power Supply PCB	960211-01 Rev. A	6-3
CRT Drive PCB	960213-01 Rev. 5A	6-7



NOTE:
1. THE UNIT OF RESISTANCE "OHM" IS OMITTED (R-1000 OHMS AND M-1MEG OHM).
2. ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE NOTED.
3. THE UNIT OF CAPACITANCE "uFD" IS OMITTED UNLESS OTHERWISE NOTED PF.

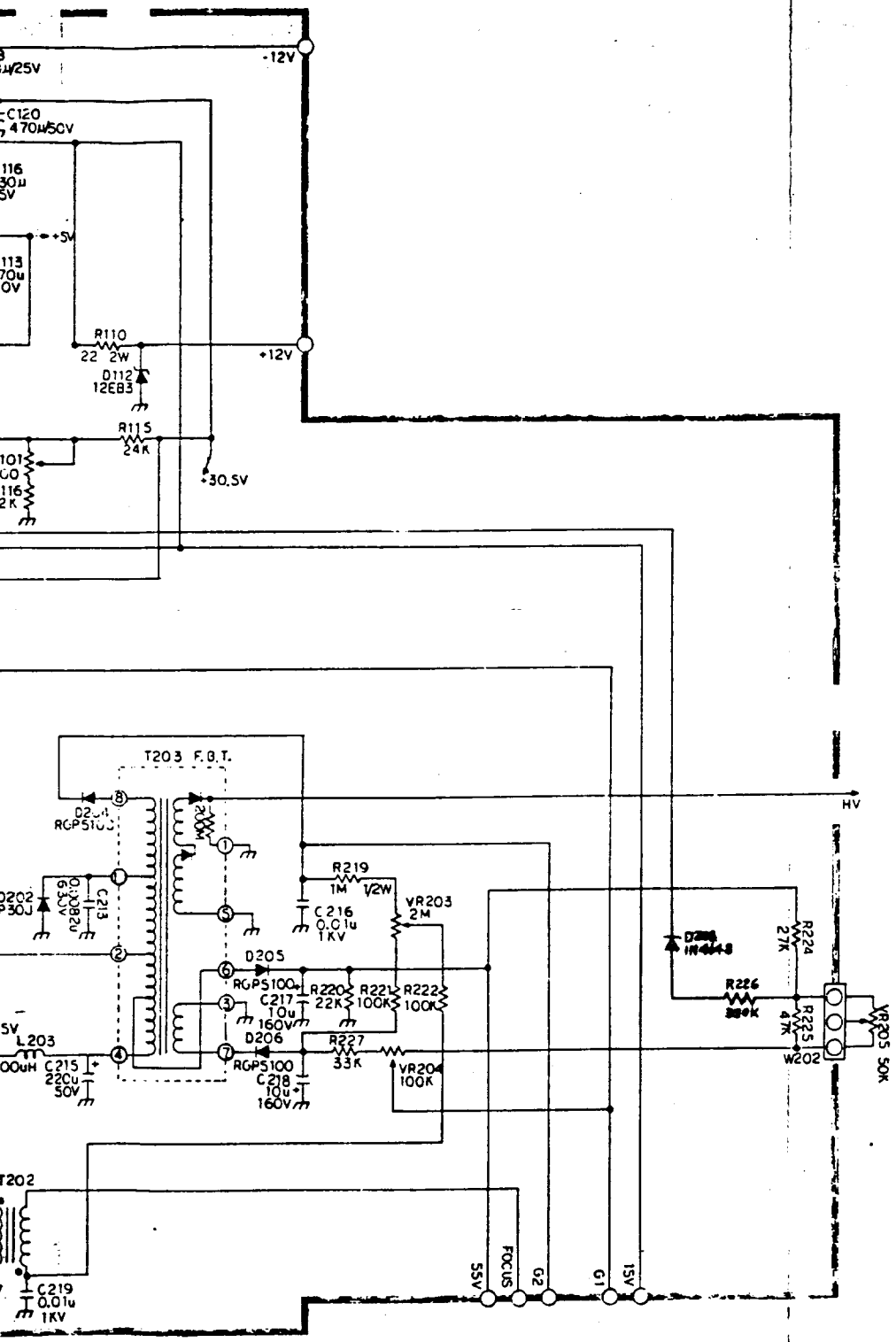
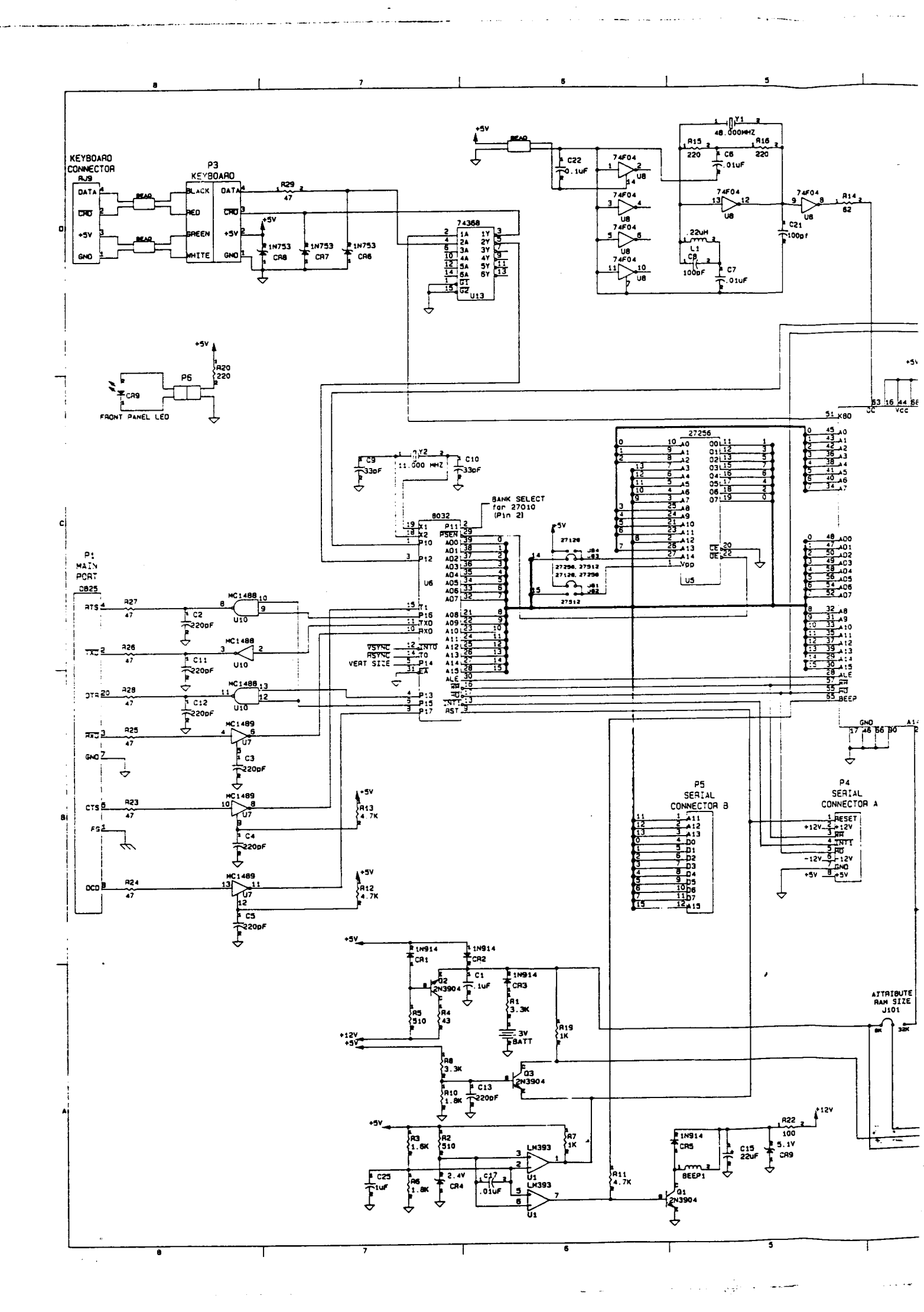


Figure 6-1
Logic/Power Supply PCB Schematic
(960211-01 Rev. A)
Sheet 1 of 2


KEYBOARD CONNECTOR
P3 KEYBOARD
DATA
GRD
+5V
GND
BLACK
RED
GREEN
WHITE
R29 47
1N753 CR8
1N753 CR7
1N753 CR6
74368
U13
+5V
READ
C22 0.1uF
74F04 U8
Y1 48.000MHZ
R15 220
R16 220
C6 .01uF
L1 .22uH
C8 100pF
C7 .01uF
R14 62
C21 100pf
P6
CR9
R20 220
FRONT PANEL LED
Y2 11.000 MHZ
C9 33pF
C10 33pF
8032
U6
BANK SELECT for 27010 (Pin 2)
27256
U5
27128
27512
27256, 27512
27128, 27256
P1 MAIN PORT
DB25
RTS
TXD
DTR
RXD
GND
CTS
DCD
R27 47
R26 47
R28 47
R25 47
R23 47
R24 47
C2 220pF
C11 220pF
C12 220pF
C3 220pF
C4 220pF
C5 220pF
MC1488 U10
MC1489 U7
R13 4.7K
R12 4.7K
VSYNC
RSYNC
VERT SIZE
BEEP
P5 SERIAL CONNECTOR B
P4 SERIAL CONNECTOR A
RESET
+12V
-12V
ATTRIBUTE RAM SIZE J101
1N914 CR1
1N914 CR2
1N914 CR3
Q2 2N3904
Q3 2N3904
Q1 2N3904
C1 .1uF
C13 220pF
R1 3.3K
R4 43
R5 510
R8 3.3K
R10 1.8K
R19 1K
3V BATT
R3 1.5K
R2 510
R7 1K
R6 1.8K
C25 1uF
C17 .01uF
2.4V CR4
LM393 U1
R11 4.7K
BEEP1
R22 100
C15 22uF
5.1V CR9

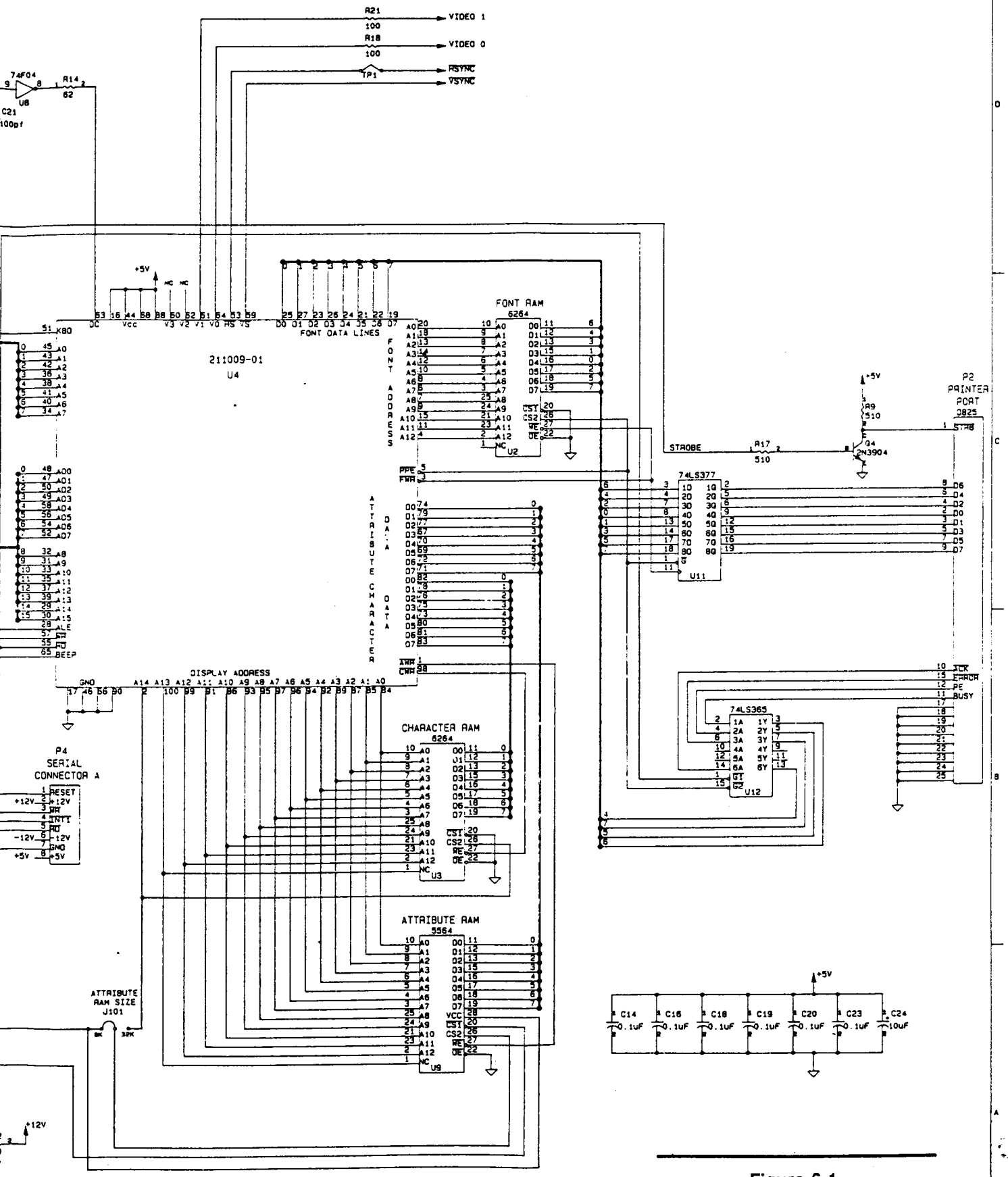
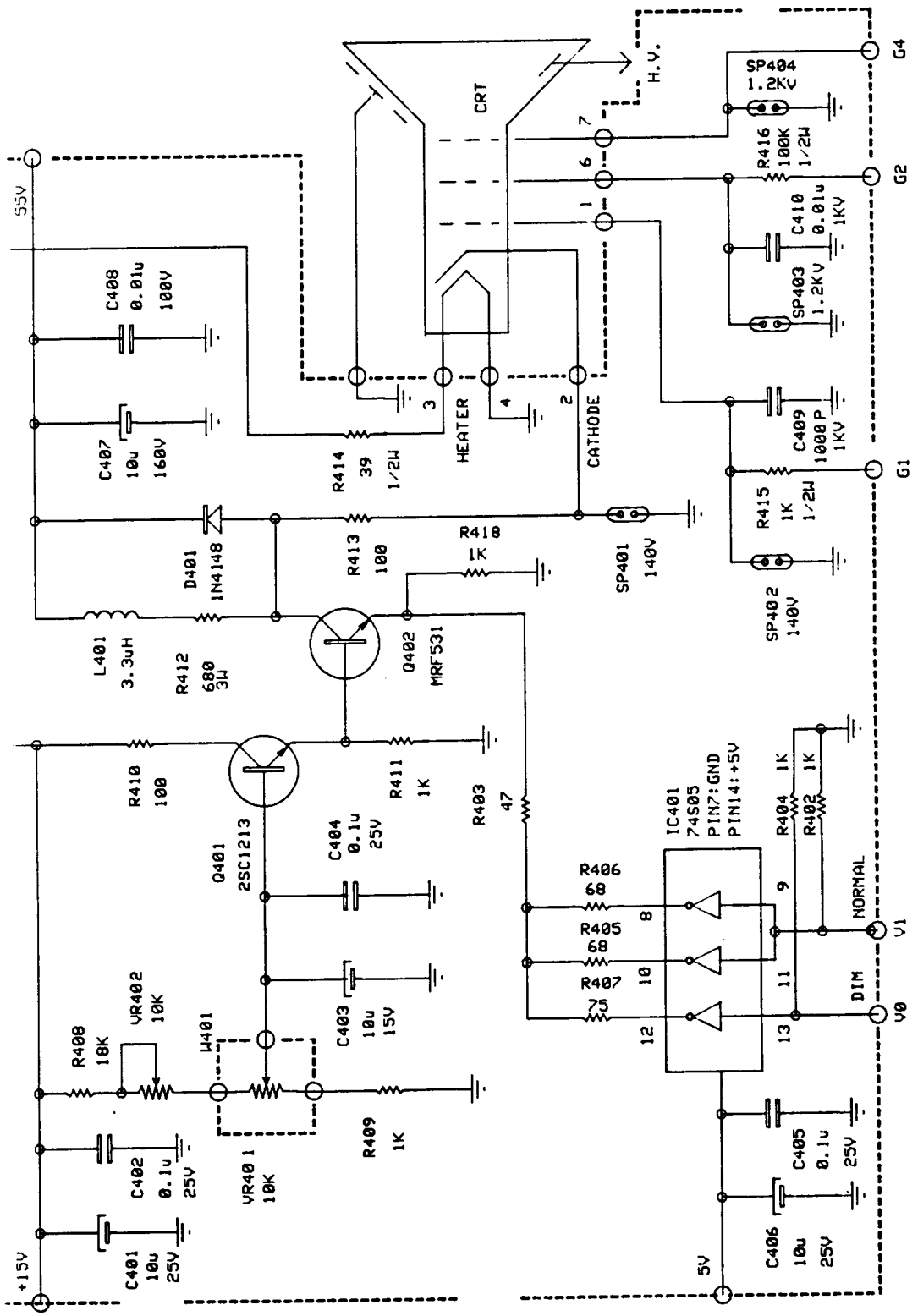


Figure 6-1
Logic/Power Supply PCB Schematic
(960211-01 Rev. A)
Sheet 2 of 2

ure 6-2 CRT Drive PCB
nematic (960213-01 Rev. 5A)



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